SIXTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CVI.]
NUMBER 23.]

NEW YORK, JUNE 8, 1912

[10 CENTS A COPY
$3.00 A YEAR

-7 1912
OF MICH

A big blast at the deepest point of the Culebra Cut.

PERSONAL IMPRESSIONS OF THE PANAMA CANAL.—[See page 516.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, JUNE 8, 1912

Published by Munn & Co., Incorporated. Charles Allen Munn, President
Frederick Converse Beach, Secretary and Treasurer;
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter

Copyright 1912 by Munn & Co., Inc.

Subscription Rates

Subscription one year $3.00
Postage prepaid in United States and possessions
Mexico, Cuba, and Panama
Subscriptions for Foreign Countries, one year, postage prepaid, 4.50
Subscriptions for Canada, one year, postage prepaid, ... 3.75

The Scientific American Publications

Scientific American (established 1845) . . . . . per year, $3.00
Scientific American Supplement (established 1876) . " 5.00
American Homes and Gardens . . . . . " 5.00

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check

Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Senate Committee's Report on the "Titanic."

THE Senate committee which investigated the "Titanic" disaster is to be congratulated upon the judicial calmness and general fairness of its report to Congress. In dealing with a disaster which has brought so much sorrow to so large a section of a community, it would have been natural for a note of bitterness to have crept into this official document.

We had occasion during the session of the committee to criticise the general drift and tone of the examination as it was being conducted by the chairman, Senator Smith. We felt that he was eliciting too many personal and unessential facts, and too little of that invaluable technical evidence upon which much of the future legislation and all future improvements in construction of ships must be based. We suggested that the Senator avail himself of the technical advice and prompting which could easily be secured among the many naval experts available in the Navy Department at Washington.

For the purpose of this inquiry, whose principal aim was to stimulate the general forward movement for the construction of practically unsinkable passenger ships, Senator Smith took the wisest and most effective step in the whole course of his investigation, when he made a flying trip from Washington, accompanied by the Chief Naval Constructor, Rear Admiral Watt, climbed down into the stoke hole of the "Olympic" (an exact duplicate of the "Titanic"), and there had a heart-to-heart talk with the leading stoker, who was in the forward boiler compartment of the "Titanic" when the iceberg ripped open her plating.

Under the practical guidance of the Chief Constructor, Senator Smith was quickly able to grasp the salient defects of construction to which the rapid sinking of the "Titanic" was due, and both he and the committee are to be congratulated upon the fact that, in the last two clauses of their recommendations, are included a set of clean-cut structural suggestions which, if carried out, will render practically impossible another "Titanic" disaster. These two recommendations alone are ample justification of the course followed by the Senate in commencing a Federal investigation of the disaster at the earliest possible moment.

The first recommendation is that: "All steel ocean and coastwise seagoing ships, carrying 100 or more passengers, should have a water-tight skin inboard of the outside plating, extending not less than 10 per cent of the load draft above the full-load waterline, either in the form of an inner shell or of longitudinal water-tight bulkheads, and this construction should extend from the forward collision bulkhead over not less than two-thirds of the length of the ship."

The second recommendation is that: "All steel ocean and coastwise seagoing ships carrying 100 or more passengers should have bulkheads so spaced, that any two adjacent compartments of the ship may be flooded without destroying the floatability or stability of the ship. Water-tight transverse bulkheads should extend from side to side of the ship, attaching to the outside shell. The transverse bulkheads forward and abaft the machinery spaces should be continued water-tight vertically to the uppermost continuous structural deck. The uppermost continuous structural deck should be fitted water-tight. Bulkheads within the limits of the machinery spaces should extend not less than 25 per cent of the draft of the ship above the load waterline and should end at a water-tight deck. All water-tight bulkheads and decks should be proportioned to withstand, without material permanent deflection, a water pressure equal to five feet more than the full height of the bulkhead. Bulkheads of novel dimensions or scantlings should be tested by being subjected to actual water pressure."

It is gratifying to the SCIENTIFIC AMERICAN to note that the above safety requirements in the construction of ships are practically identical with those which were outlined in the article on the "Unsinkable Ship" which appeared in the SCIENTIFIC AMERICAN of May 11th. Although the other recommendations of the committee are, to our mind, secondary in importance to those having to do with structural safety, they are all to the point and cover fully the lessons which have been taught by this disaster.

The committee recommends that unless there is early revision of the inspection laws of foreign countries along the lines suggested in its report, the existing reciprocal arrangement regarding the inspection certificates of foreign countries be terminated, and that no vessel shall be licensed to carry passengers from ports of the United States until all regulations and requirements of the laws of the United States have been fully complied with.

It is recommended that the statute be so revised as to definitely require sufficient lifeboats to accommodate every passenger and every member of the crew; that not less than four members of the crew skilled in handling boats shall be assigned to every boat; and that these crews shall be drilled in lowering and rowing boats not less than twice in each month. It is further recommended that passengers and crew be assigned to lifeboats before sailing, the assignment of boats and the shortest route from stateroom to boat to be posted in every stateroom. It is also recommended that every ocean steamship carrying 100 or more passengers be required to carry two electric searchlights.

The committee finds, furthermore, that this catastrophe makes glaringly apparent the necessity for the regulation of radio-telegraphy. There should be an operator on duty at all times, and direct communication should be provided either by telephone, voice tube or messenger between the wireless room and the bridge, so that the operator shall not have to leave his station. Legislation is suggested to prevent interference of amateurs, and some source of auxiliary power should be installed so as to insure the operation of the wireless plant until the wireless room is submerged.

The House Naval Appropriation Bill

EVERYONE who has any intelligent appreciation of the naval situation will greatly regret the action of the House of Representatives in defeating an amendment providing for the construction of two new battleships. The amendment offered by Representative Roberts called for two battleships to cost not more than $6,000,000 each. He stated that not since the Fifty-ninth Congress had a naval bill been passed that did not make provision for fighting ships. He drew attention to the fact, of which the country at large is fully aware, that the policy of constructing two battleships a year had not been adopted for the purpose of building up a great navy, but merely with the object of maintaining the navy at its relative efficiency among the navies of the world.

It is highly probable that when the matter comes up for discussion in the Senate, a bill will be passed authorizing the construction of these two first-class ships. In the meantime the House of Representatives will have time for serious reflection, during which if the time be employed to good purpose, the members who voted against the continuance of our naval policy will learn that they are thoroughly out of touch with the general sentiment of the people of the country on this most vital question. It is our earnest hope, as we believe it is of the great majority of the country's taxpayers, that when the bill goes to conference, the two houses will agree to maintain our very conservative and time-honored policy. The House adopted an amendment providing for the construction of two fuel ships to be constructed in government navy yards, and for six torpedo-boat destroyers, one tender to destroyers, four submarines and one submarine tender.

Shortcomings of Wireless at Sea

WHEN the first reports of the accident to the "Titanic" and the transfer of all her crew and passengers to the "Carpathia" reached the general public, it was thought that wireless telegraphy had scored another great triumph like that at the time the "Republic" was sunk. Even when it was learned that the vessel was lost and that only a small part of her human cargo had been rescued, the praises of wireless telegraphy were still sung; for had not the prompt response of the "Carpathia" to the C. Q. D. call resulted in the saving of many lives? But during the long days of suspense before the full details of the disaster were brought in, there were many mutterings against the slow pace of the rescuing vessel and the inadequate wireless equipment, which could carry but eighty-five nautical miles. Many realized then for the first time how completely isolated a passenger vessel might be upon the high seas. A circle of eighty-five-mile radius on a six-inch school globe could nearly be covered by a pin head. It seems as though measures should be taken to require passenger vessels to carry a wireless equipment with a range of several hundred miles at least. But the full measure of the failure of wireless telegraphy to meet the crisis came out when it was shown that the steamship "Californian" was actually within sight of the wreck, and yet heeded not its wireless signals because its wireless operator was asleep. Had it not been for the amazing indifference or stupidity of the captain of the "Californian" who failed to rouse his operator when he saw the rockets fired by the "Titanic," no doubt all on board might have been saved, or at least a far larger number than was saved by the "Carpathia," and the public would have overlooked the weak feature of the system that prevails on the smaller passenger vessels of providing only one wireless telegraph operator. Of course, the wireless operator must have some sleep, and it is natural for him to use the hours after 10 P. M. when there are few messages circulated through the ether. Yet the hours of night are more dangerous than those of day, and the veriest tyro could see the importance of having the wireless equipment of a vessel in full working order and operation all night and throughout all the hours of thick weather.

It is a pity that wireless telegraphy requires a special operator. If only a successful means of communicating speech instead of Morse signals could be developed it, would be a very simple matter to provide for the receipt and transmission of messages by some member of the crew while the regular operator was taking his rest. It is a pity too that Hertzian wave signals are so weak that a telephone receiver must be employed to detect them. With such weak signals, it is evident that any signaling apparatus which could serve as a call for the operator in time of danger would have to be so extremely delicate as not to be reliable under all circumstances.

It seems inevitable then that in order to secure perfect safety at sea, every vessel must be supplied with at least two operators, so that one man will be on duty all the time. This is a requirement that was evidently overlooked completely in the recent Government regulations requiring all vessels carrying over fifty persons to be equipped with wireless telegraph apparatus. In the report of the Senate committee that investigated the loss of the "Titanic" the necessity for regulating radio-telegraphy is emphasized in the recommendation that "there must be an operator on duty at all times day and night to insure the immediate receipt of calls of distress, warning or other such calls." It also recommended that there be some means of direct communication either by telephone, tube or messenger between the wireless room and the bridge, so that the operator will not have to leave his station. If these recommendations are carried out, and it be made compulsory for all vessels to carry two operators, no doubt a heavy expense will be laid on the steamship companies, but surely we do not need another catastrophe like that of the "Titanic" to demonstrate the importance of such a measure.

Travel at sea has been so safe that until now very little thought has been given to the actual dangers which might be circumvented by wireless telegraphy. But now there is no doubt that action will speedily be taken to overcome all the weak features of the system. The Senate committee points to the necessity of providing some source of auxiliary power, either storage batteries or oil engines, to insure the operation of the wireless apparatus until the wireless room is submerged. Attention is also brought to the necessity for definite legislation to prevent interference by amateurs and to secure secrecy of radiograms or wireless messages. Another point brought out by the Senate investigating committee has to do with the handling of messages by the wireless operator on the "Carpathia." The committee does not believe that "proper vigilance" was exercised and points to the fact that the precedent set by the operator of the "Republic" in selling his story may have had some effect on the "Carpathia's" operator. However that may be, wireless telegraph operators should certainly be prohibited from selling information. The work of the Senate committee has been very thorough and its recommendations are conservative. There is no doubt that a great improvement over the lax conditions that have prevailed in the past will speedily follow.

Electricity

Reclamation of Worn-out Machinery by Electric Welding.—Electric welding of unusual interest has recently been accomplished by a New York city electric street railway company, using a portable welding plant to reclaim from the scrap heap motor shells, oil cups, axles, and gear cases. Although many of these parts were very "far gone" ingenious work made them all good for another term of usefulness. Both the carbon arc and the metallic arc were used, with currents of 300 amperes and over, at about 110 volts.

New Electrostatic Voltmeter for Very High Pressures.—A new instrument for the direct measurement of high electromotive forces (up to 150,000 volts) without the use of condensers has been constructed. This voltmeter has a uniform scale from about 30 per cent of its total deflection to the end of the scale. Oil is employed as the dielectric, with the advantage that the attractive force is greater in oil than in air on account of the high dielectric constant of the former. Oil, moreover, has a greater disruptive strength, and affords protection against disturbances due to atmospheric influences.

Influence of Alloy on Electrical Conductivity.—The influence on the conductivity of metals of change of temperature, or of admixture of other metals, was emphasized in a recent discussion of electric conduction. The conductivity of pure metals increases with falling temperature at approximately the same rate for all the metals, and the presence of certain impurities in copper and iron even in very small amounts, affects their properties to a very great extent. Thus, one-tenth of one per cent of arsenic reduces the conductivity of copper by 30 per cent.

The Production of Automobile Magnetos.—In a note published in *La Nature* we read that in Europe the great majority of magnetos for automobiles are made in Germany, which shows an annual production of 250,000 to 300,000, giving occupation to from 4,000 to 5,000 workmen, and representing a value of $8,000,000. France, in spite of its highly developed automobile industry, produces only 15,000 magnetos, quite an insufficient number for the home consumption, which amounts to 70,000 ignition apparatus. There are imported every year 55,000 magnetos into France from Germany.

Working on Live High-tension Lines.—A drawback to high-tension electric service has been the necessity of shutting off the power in order to make repairs on the line. During the past winter the line foreman of an Ohio electric railway devised a method of renewing cracked insulators, broken tie-wires or defective pins and changing cross-arms on poles on high-tension lines without shutting off the current. A two-piece tie-wire is used which can be attached to the insulator before "tying in" the line conductor, and the tying in is done by a special tool. Another special tool is employed to raise the line conductors above the top of the pole in order to change cross-arms.

A Plowed Field as the Line Conductor.—A copper conductor of a 100,000-volt transmission line into Denver, Colorado, was recently burned in two at the center of a 500-foot span two miles from the city by contact with a ground wire, and the ends of the conductor fell to the earth (a plowed field). The accident took place at 1 A. M., when the system was carrying 3,700 kilowatts. Although the broken ends of the conductor formed cone-shaped fulgurites in the clay soil, where the earthy matter had been fused into slag, the field carried the load for seven hours. The gradual burning back of one of the wires left a short length dangling from one of the towers of the span and making an intermittent arc with the ground, and the resulting current surges, revealed in the swinging of the station instrument pointers, finally attracted the notice of the station attendants. It was found that a glassy path had been formed in the field, where the current had melted the soil; and for several feet near this path the ground remained too hot to stand upon for three hours after the current had been shut off.

Electrolytic Damage by Stray Currents.—The present city administration of Chicago has actively studied the question of damage to sub-surface metallic structures—gas and water mains, lead-sheathed cables, steel buildings and steel bridges—by stray currents from street railway return circuits. A definite proposal for a remedy has now been advanced, in the form of an ordinance containing stringent requirements for all uninsulated "return conductors." Such conductors must be of sufficient current-carrying capacity and must be so arranged that the maximum potential difference between any point on the return circuit and the supply station shall not exceed 12 volts. The density of current flow on pipes and cable sheaths is specifically limited, and return conductor systems must be equipped with pressure wires and recording voltmeters. The installation of additional conductors and sub-stations, and the other reforms to existing conditions will involve a large expenditure by the railway companies—probably four to five million dollars.

Science

Chemical Caterpillars.—The work of former investigators, Tichomorrow, Toyama, and Kellogg, has been substantiated by Mr. Ripley of the Department of Biology, Trinity College, Hartford, Conn. Mr. Ripley has produced caterpillars from unfertilized eggs by the action of sulphuric acid, and has therefore carried one step farther the investigation of his predecessors in the production of larvæ.

Cornell's Seven Wonders.—The Physical Department of Cornell University was asked some time ago to name seven wonders of the modern world selected from a list of fifty-seven outstanding inventions and structures. The faculty, graduates and seniors in the Physics Seminary balloted, the award of the voting going to Wireless Telegraphy, Synthetic Chemistry, Radium, Anti-toxins, Aviation, the Panama Canal, and the Telephone.

The Japanese South Polar Expedition, under Lieut. Shirase, after refitting its ship in Sydney, made a second journey to the Antarctic early this year. At the Bay of Whales the Japanese met Amundsen's party returning from the south pole. Discouraged by Amundsen's success, they abandoned their own polar project, spent a few weeks in botanical and zoological exploration as far south as latitude 80½ degrees, and returned to Wellington, N. Z., in March.

A New Explanation of Earthlight is given by Prof. W. J. Humphreys in a contribution to the *Astrophysical Journal* entitled "On 'Earthlight,' or the Brightness, exclusive of Starlight, of the Midnight Sky." The phenomenon is one to which general attention has only recently been drawn. (See SCIENTIFIC AMERICAN, November 19th, 1910, p. 394.) It has been plausibly explained by Yntema and others as due to a continual feeble electrical discharge in the upper atmosphere—a "permanent aurora." Humphreys points out that any explanation must take into account the effects of the bombardment of the atmosphere by meteors and meteoric dust. Such material would illuminate the sky not only directly, by their incandescence, due to friction, but also probably indirectly, owing to the abundant ionization that their high temperatures and velocities would produce in the upper atmosphere.

Substitute for the Diapositive for Projection Purposes.—Up to the present, in making lantern slides it has been necessary to prepare diapositives by taking the time and trouble to photograph the cuts from periodicals and books and then copy them. The German *Zeitschrift für Elektrochemie* reports in its current issue that the publishing firm of Wilhelm Knapp & Co. in Halle has succeeded in reproducing negatives directly on transparent films which are then put into frames of pasteboard or sheet zinc, or better yet, are placed between thin plates of glass, and make an excellent substitute for glass diapositives. The great advantage in their use is that they are very easily and quickly made, but a feature of the case which is not to be neglected is the ease with which they can be shipped or carried about. A lecturer can carry in his pocket more slides than he could lift if they were on glass.

Predicting Earthquakes.—That excessive terror naturally produced by the shaking and sundering of the solid earth and the attendant downfall and ruin of substantial edifices has been increased a thousand-fold in earthquake zones by the apparent impossibility of foreseeing seismic disturbance long enough beforehand to take even elementary precautions against fatalities. A trained geophysicist, M. Koeveslighety, has long been working on this problem and announces his belief that he has now partially solved it. He considers that the primal cause of the earthquake is not external factor whether cosmic or meteorological. Such factors at most merely precipitate the shock, which is actually due to excessive tension at some point. The essential thing, therefore, is to learn where such tension exists, and this he considers by no means impossible. The speed of propagation of seismic waves varies according to the elasticity of the strata traversed, and this elasticity itself depends on the tension. Consequently if this speed be measured at repeated times between two given points, it will be seen whether the tension varies. If this tension shows a tendency to increase, seismic shocks are to be feared. In other words, the elasticity will reach a critical degree, where a breaking of the strain may be occasioned by some exterior disturbance. In short, the case is analogous to that of an explosion produced by a spark in gunpowder. Hence it would be well in regions subject to seismic disturbance to take frequent measurements of the speed of earthwaves and estimate the corresponding variation in elasticity. Thus a probable rupture of tension might be predicted, and even the time of its occurrence estimated. The method was tested with favorable results in the vicinity of Tokio during the period from 1895 to 1898. Further testing by exact observations on a large scale are advisable in such regions as Sicily, Calabria and California, since the theory is quite logical but needs empirical attestation to be generally accepted.

Aeronautics

Another Licensed Woman Aviator.—Mrs. Julia Clark, of Denver, the first woman to take a complete course at the Curtiss Aviation School, San Diego, Cal., qualified on May 19th for her aviator's license. She flew in a fifteen-mile wind at an altitude of eight hundred feet.

Aeroplanes Demanded for Western Army Maneuvers.—Application has been made to the War Department by Brigadier-General Marion P. Maus for a number of aeroplanes for the carrying of messages and sending the same by wireless at the maneuvers for five thousand regular troops and of the National Guards of Washington, Oregon, and Idaho. These maneuvers will be held between Puget Sound and Gray's Harbor, beginning July 20th.

Pensions for Army Air-men.—The German Reichstag on May 21st passed the first and second readings of a bill providing pensions for military aviators. The measure ranks accidents occurring to army air-men while flying on the same level as casualties incurred in time of war. France has made a similar provision. German professional aviators recently made a demand for a minimum wage of $75 per month. Some have been getting as low as $37.50, and there is general discontent.

Aeroplanes for Coast Defense.—It has been decided to station a hydro-aeroplane at Bedloe's Island, where the Statue of Liberty is located. Another machine will be stationed at Governor's Island, and two more will be placed at the Washington Barracks on the shore of the Potomac River. Floats have been ordered for the two Wright and Curtiss biplanes now at College Park, Md. It is planned to have in the future hydro-aeroplanes at all the coast defense stations, and the machines now in use in the army will be commissioned until others can be built.

A German Reliability Test.—On May 21st three of eight officers and one civilian who started on May 12th from Strasburg on a reliability flight, each carrying a passenger in his aeroplane, completed their task. They arrived safely at Constance. The civilian competitor, the well-known aviator Hirth, made the best performance. Most of the competitors were eliminated on the first day of the competition while crossing the Vosges Mountains in the face of a gale. A Zeppelin dirigible balloon accompanied the air-men along most of the stages.

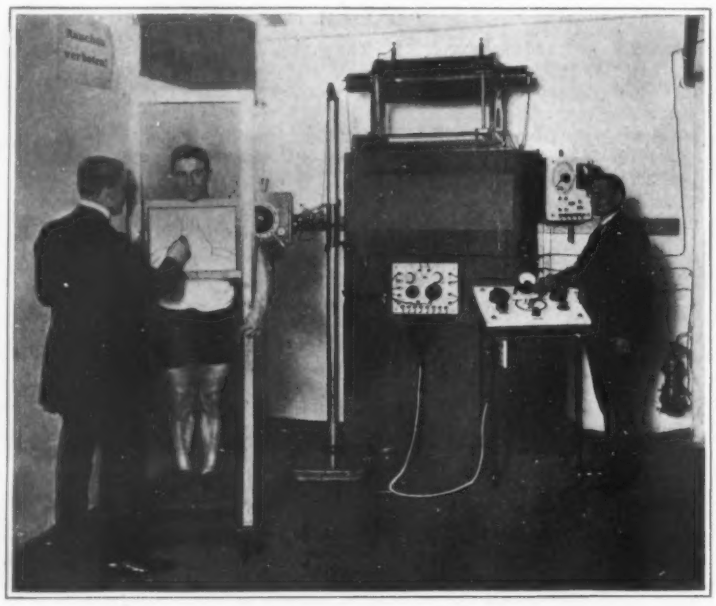
Delivering Papers by Aeroplane.—On May 29th Farnum Fish made a fifty-mile flight from Milwaukee to Watertown, Wisconsin. He carried a bundle of newspapers and dropped some off at the various towns *en route*. He made the flight against a strong head wind and flew across Milwaukee at an altitude of only about five hundred feet. A few days before this he made a flight from Chicago to Milwaukee in two hours and six minutes, carrying a consignment of silk for a department store. Most of this flight was made at a height of 6,000 feet and an average of 72 miles per hour was maintained.

Loss of the Dirigible "Parseval VI."—On May 25th the "Parseval VI" was torn from her moorings when floating at anchor at Leipzig. The airship had arrived early in the morning and had been moored in the open field. Unfortunately, a gale arose and the airship broke away and was destroyed. The "Parseval VI" was of the non-rigid type used almost exclusively by the German army. It had met with several accidents heretofore, notably on March 16th, 1911, when it was dashed against its shed at Johannesthal, and again on April 22nd of last year. On May 17th, 1911, the "Parseval II" was totally wrecked at Bitterfeld, and on June 27th the "Parseval V" was destroyed by fire, near Hanover. Thus it will be seen that these non-rigid airships have had nearly as bad luck as the huge rigid Zeppelins. Nevertheless, a number of both types are now being used very successfully for the carrying of passengers.

A New Passenger-carrying Blériot Monoplane.—The new monoplane which Miss Harriet Quimby has recently imported for her own use in making pleasure flights, is the latest passenger-carrying model turned out by the Blériot factory. This machine has several novel features, and differs considerably from former passenger-carrying Blériots. The 70 horse-power Gnome motor is mounted in front of the cross bars of the chassis and the seat for the passenger is placed in the body about four feet back of the pilot's seat. The body is covered with aluminium sheeting on top between the pilot and the passenger, so that the general appearance is that of a tandem monoplane. A very small tail, with hinged elevator in two parts at its rear edge, is fitted below the body at the rear end. This tail is not much over four feet wide and is somewhat less in depth from front to rear. The vertical rudder is fitted above the tail. A new form of skid is braced by elastics, and this supports the body when the same is at rest.

Radiographic Study of the Effect of Exercise on the Heart

ATHLETIC contests, such as six-day bicycle races, afford excellent opportunities for scientific study of the effects produced on the muscular tissue of the heart by extraordinary bodily exertion. German physicians, therefore, made elaborate preparations for studying these effects in connection with the six-day bicycle race which recently took place in the Sportpalast in Berlin. For this purpose a large and finely-equipped Roentgen-ray laboratory was established. The heart of each contestant was radiographed immediately before the race and at regular intervals during its progress. The radiographs thus obtained furnish a permanent graphical record of the changes produced in the dimensions of the heart by hard and prolonged work. In each experiment a drawing of the heart, as shown by the Roentgen rays, was made, in addition to the photograph. One of these drawings, representing the heart of a professional bicyclist, is herewith reproduced.



Radiographing the heart of a professional bicyclist.

Exercising in Bed

THE influence exerted by passive exercise upon the circulation of the blood in healthy persons, a subject on which no conclusive evidence has hitherto been obtained, is being studied in the medical clinic of the University of Tübingen, with the aid of an apparatus consisting essentially of two arms or pedals, to which reciprocating motion is given by an electric motor, mounted on a wheeled carriage. The pedals are attached to the legs of the patient as he lies in bed. In this way passive walking and climbing movements are transmitted to the legs and the distribution of the blood circulation is altered. The circulation in the legs is increased, while the arteries of the arms contract in compensation, and the blood flows through them more rapidly for this reason, and also because the contractions of the heart are increased in volume. As the acceleration of the heart beat, which is produced in most persons by violent active exercise, is here lacking, the circulation is influenced in a very gentle manner by passive exercise of this sort. Hence, this method is especially well suited for use in mild and moderately severe cases of cardiac insufficiency, for producing a minimal increase in the action of the heart, in the safest manner conceivable. As the apparatus can be wheeled to the bedside, it can be employed in the treatment of patients who are confined to the bed.

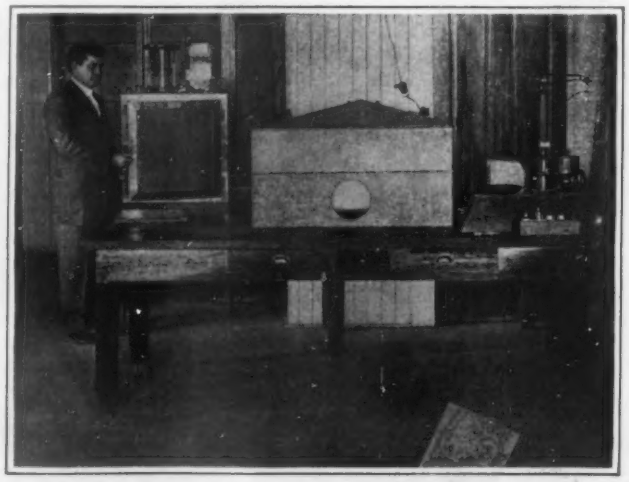
Portable apparatus for use in circulating the blood by passive exercise in bed.

Ripening Dates Artificially

SOME parts of the desert in California and Arizona which are suitable for the cultivation of the date palm have the one drawback, that the natural heat cannot be depended upon to bring the fruit to perfect ripeness. Some years will result in large marketable crops, while others will yield little because of insufficient heat. To eliminate this uncertainty, Prof. George Freeman of the Agricultural Experiment Station, University of Arizona, has invented a device which will ripen the fruit artificially to perfection. It is exceedingly simple and inexpensive, a fact which makes it commercially available. In fact, it has been used already on a commercial scale, as 100 pounds can be treated at one time in his laboratory. The device consists of a metal oven, in which dates are placed, after being picked when they just begin to ripen. A preliminary washing is needful, after which they are kept in an even temperature of about 50 deg. Cent. (122 deg. Fahr.) for three days and in a moist atmosphere. This renders them as sweet and delicate in flavor as the naturally ripened fruit, and far superior as a table delicacy to the dried and pressed dates with which we are familiar. The process is also used to restore dates which have remained upon the tree until withered. The moisture brings back their plumpness and flavor, while their wholesome qualities are not impaired.

Ripe dates treated in this way are boxed like choice confectionery. They will stand shipment to all parts of the United States and Europe, as experimental consignments have shown. The industry is growing rapidly in the Southwest and promises to become of importance.

Prof. Freeman preparing dates for artificial ripening.



Zinc ripening ovens with a capacity of 100 pounds of dates.

Deep-sea Creatures that are Luminous

WRITING on deep-sea luminosity in animal life, in a late number of *Touche à Tout*, the Abbé Moreux comments on the assumption of Lamarck and Darwin that eyes did not exist at vast depths in the ocean because there was no use for them in regions unpenetrated by the solar rays, and speaks of modern discoveries showing wherein the earlier theory was erroneous, despite its apparent plausibility. He continues: Certain specimens, to be sure, like the Gastrotomus of Baird, do not possess visual organs, but along their bodies are ranged rows of phosphorescent plates. If they have no eyes, why is their progress illuminated? A mystery!

But let us examine a brother creature, from which we may gather instruction—the Photostomias. Captured at a depth of 1,138 meters, this has two eyes with which to see, and since it inhabits a region of tenebrous shades, it illuminates its path by luminous organs situated beneath its eyes and disseminated in every part of its body.

A large number of fishes, indeed, are phosphorescent. Some do better still; their heads bear regular searchlights like those of an automobile, which they can cause to shine at will. Others, lucky enough to possess a living bait attached to a long thread, light their lanterns and thus go out fishing.

But there are even more perfect representatives of this singular sort of fauna. Within their eyes, which are voluntarily extensible, like marine glasses, are set true lenses whose convexity varies according to the focus, while diverse colors shimmer in the sheaves of luminous rays which they project to a distance. This whole world of deep-sea life which we formerly regarded as buried in obscurity is illumined by a fairy light which it itself produces, in default of solar rays. Very often, too, the inhabitants of these abysmal deeps glow with the most brilliant colors. There are fishes clad in azure velvet, crustaceans with cuirasses of opal or emerald, sea-urchins tinted with ruddy gold or transparent vermilion, sponges reflecting the hues of the sapphire.

Gathered heaps of precious stone, sparkling in the fires of the sun, would not avail to give us an idea of the magic spectacle we might enjoy in the deep bosom of these abysses filled with throbbing life.

Molten Glass as a Conductor in the Electric Furnace

A NEW form of electric furnace for the melting of dross, scrap metal and cyanide precipitates, utilizes the arc at the start and afterward the electric conductivity of melted glass to maintain the action. On beginning the melting the furnace is partly filled with broken glass and the carbon electrodes adjusted into contact and then drawn apart forming an arc. As the glass melts it becomes conducting, and the carbons are drawn farther apart until the entire mass is molten. The dross, etc., is then charged into the furnace, and is melted by the initial heat of the glass. Owing to its higher specific gravity the melted metal falls to the bottom, where it is protected from oxidation.

The Great Tower Telescope of the Mt. Wilson Solar Observatory

A Description of the World's Largest Reflector

By Dr. E. A. Fath, Mt. Wilson Observatory

IN 1907 there was erected at Mt. Wilson a tower telescope 60 feet in height for solar work. This instrument was the first of its kind ever constructed. For this reason it was in a large measure an experiment, but one which proved such a success that, after a year's work, Director Hale began to plan for a much larger one with all the improvements which experience had shown to be desirable. The result of this planning is the great tower which is the subject of this article.

In such an instrument the optical parts must be solidly mounted so that they cannot be shaken by the wind; they must not be sensibly distorted by the strong sunlight falling on them; the beam of light from the sun must be received at as great an altitude above the ground as possible; the tower must be sufficiently high to permit the use of a lens of great focal length, so as to give a large image of the sun when such is desired; the auxiliary instruments must be large to obtain large-scale photographs of the solar spectrum, etc., and must be so placed that there shall be neither flexure nor change of temperature during exposures lasting, possibly, several hours.

In order to simplify matters let us consider the tower telescope as merely a telescope of the usual type but of very great length. On account of this great length it would be very troublesome to mount it so that it could be moved to follow the sun across the sky. It is therefore fixed in a vertical position,* the usual tube for supporting the lens being replaced by the frame of the tower. But now that the telescope is fixed some way must be found to direct the beam of light into it and at the same time allow for the motion of the sun. The device† adopted consists of two plane mirrors, one moving and the other fixed. The broken line with arrows in Fig. 1 shows the course of the light.

Let us consider the optical parts first and afterward the general construction of the telescope.

The first mirror (*A* in Fig. 1), which is 19 inches in diameter, is called a coelostat because it is mounted in such a way that its axis of rotation is parallel to the earth's axis and lies in the plane of the reflecting surface. The rotation about its axis is produced by means of a driving clock similar to that of an equatorial telescope. The mirror rotates at such a rate that the reflected beam has a constant direction. In this case it is upward toward a second plane mirror *B*, of 15 inches aperture, so placed as to reflect the beam vertically downward.

A unique device has been adopted to make these mirrors extremely rigid so that they will not be sensibly distorted by the sun. This consists in making them very thick. Thus the coelostat mirror is 13 inches and the other 11 inches in thickness. This device has proved so efficient that exposure to the sun for hours at a time produces no serious distortion.

Any errors in the rate of the driving clock can be corrected by means of a differential gear and motor controlled electrically from the observing room at the base of the tower. This corrects for east and west errors. North and south deviations can be corrected by means of a motor geared to the mirror *B* and also controlled by the observer below.

After leaving the mirror *B* the beam passes through a lens *L* of 12 inches aperture and is brought to a focus at *F* (Fig. 2) 150 feet below. To permit accurate focusing the lens can be moved vertically. This, too, is accomplished by means of an electric motor controlled by the observer.

For some investigations the large solar image (17 inches in diameter) formed by the lens *L* may not be desirable. When this is the case lenses of 60 or 30 feet focus can be used, being supported at these respective heights above the point *F*.

The apparatus thus far described has been designed to produce the best possible image of the sun in the observing room. We now come to the two* instruments which are used for the investigations proper. The one is a spectrograph and the other is a spectroheliograph. The first is used to study the spectrum of the sun. It shows what elements are present in the solar atmosphere; and by means of a small additional piece of apparatus, can also be used to determine the rotation period of our great luminary, etc.

The second instrument, the spectroheliograph, is used to determine the distribution of the various gases and vapors in the atmosphere of the sun. Thus it is possible by means of it to isolate the light coming to us from the hydrogen in this atmosphere and then to photograph it. We thus obtain a picture showing the sun as if it consisted of hydrogen only. Similarly it is possible to get pictures with the light of calcium vapor alone, or iron, etc. As changes are continually going on, a series of photographs taken at comparatively brief intervals shows profound movements of hydrogen or calcium. In Fig. 3 an enormous hydrogen cloud or prominence is shown at the edge of the sun.† This formed and disappeared in about 48

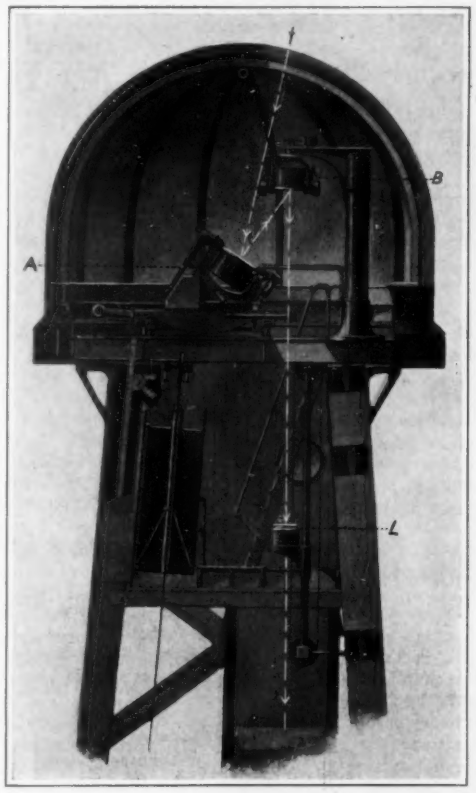


Fig. 1.—Course of the light in the tower telescope.

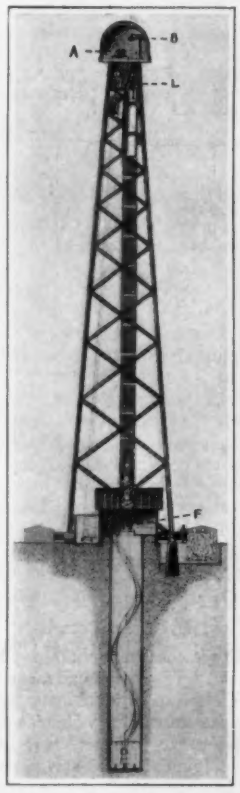


Fig. 2.—The tower and its base.

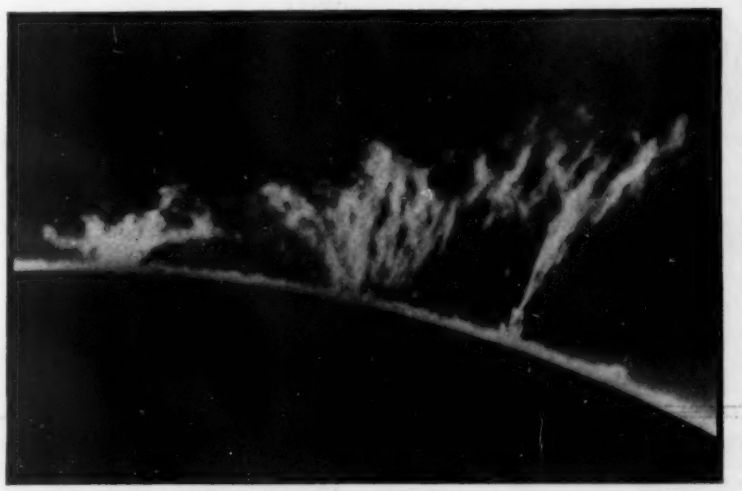


Fig. 3.—Great hydrogen prominence, photographed on August 21st, 1909,

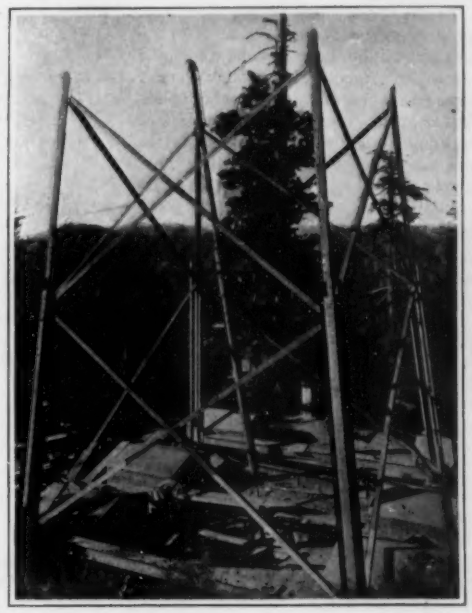


Fig. 4.—Two complete sections of the light inner tower in place.

Fig. 5.—The dome completely open.

THE GREAT TOWER TELESCOPE OF THE MT. WILSON SOLAR OBSERVATORY

* The longest telescope at present that can be moved in this manner is the great 40-inch refractor of the Yerkes Observatory which has a focal length of 63 feet. Fixed telescopes have been used for many years at various observatories but they have been mounted horizontally.

† Attention should be called to the fact that the reflection occurs directly from the silvered surface, the light not penetrating the glass at all. The silver film thus exposed tarnishes in time and must be renewed. This is done about twice a year.

* There is in reality but one combination instrument but for our purpose it is best to consider this as two separate instruments.

† This particular photograph was taken with the spectroheliograph of the 5now horizontal telescope.

hours. Similar formations have been known to come and go in one-tenth the time. The tremendous velocities and masses involved can hardly be appreciated, for one inch in the figure corresponds to nearly 50,000 miles at the surface of the sun.

The two instruments mentioned are each 80 feet in length and placed vertically in a well of the same depth. These instruments project upward into the observing room about 3 feet to the level *F* (Fig. 2) at which the image of the sun is formed. The light enters either instrument at this point and passes down its length to the bottom of the well. It is there analyzed by either prism or grating and then reflected back a little to the side of *F* where the photographic plate is located. Plates up to 36 inches in length may be used.

Now that we have considered briefly the arrangement and use of the optical parts, we are in a better position to appreciate the general construction of the tower, etc.

One of the difficulties with all telescopes used for refined work is their liability to be shaken by the wind. To provide against this a very ingenious plan was adopted. The tower is double, or rather, there are two complete towers, one within the other, each with its own set of piers and nowhere touching. This can be seen best in Fig. 4, where two complete sections of the light inner tower are in place while the outer tower, which is to inclose the inner, member by member, has just been started, only the lowest horizontal and first vertical members being in position. Each member of the outer tower is of box construction, within which is the corresponding member of the inner tower. All the optical parts above the observing room are supported by the inner tower while the outer carries the dome and completley shields the other from the wind.

The huge concrete piers for the outer tower, eight in number, are in part shown in Fig. 4. The relation of the piers of the two towers is best seen in Fig. 2, the piers for the inner tower being the ones extending just to the surface of the ground.

The erection of this double tower afforded considerable difficulty, as it was quite different from the ordinary structural steel job. The general scheme, however, can be seen from the illustrations. The men worked on platforms suspended on the outside. The steel was put into place by a gin pole and the usual hoisting engine. When a section of the inner structure was in place each member was inclosed by the corresponding box-like member of the outer. Great care was necessary that neither was in contact with the other at any point. A clearance of 3 inches between the two permits considerable vibration of the outer tower without affecting the inner.

The dome is not of the usual type. It consists of two half-domes, one slightly larger than the other. When closed the two halves fit snugly together and afford good protection from the weather. Upon opening, the smaller section can be rotated until it is wholly within the other, thus leaving one side entirely open. In Fig. 5 it is open to its fullest extent. It will be recognized that this dome has about the same relation to the tower telescope that the lens cap has to an instrument of the ordinary type.

Down the center of the tower can be seen a square tube made of sheet iron. About this are placed canvas *louvres* to protect it from direct sunlight. By this means troublesome radiation effects are eliminated in the air column through which the beam of light passes after leaving the lens.

The observing room is shown in Fig. 2. It is at the base of the tower and directly over the 80-foot well. There is a photographic dark room in connection with it. The entire structure is of reinforced concrete.

The height of the tower from the ground level to the floor of the dome is 160 feet. The dome adds 13 feet more, so that the total height is 173 feet. The weight of the steel used in the construction is 150 tons. The eight concrete piers for the outer tower weigh about 70 tons each, while the four piers for the inner tower each weigh 19 tons.

The well, which is 10 feet in diameter, was sunk into the rock before the tower was erected. It is lined with an 8-inch concrete wall. A spiral stairway, as shown in Fig. 2, provides an easy way to reach the optical parts at the bottom of the well whenever these need adjustment. The well has a special advantage in that it has practically the same temperature throughout the year. This constancy of temperature is of prime importance for the prism or grating in the spectrograph or spectroheliograph. Very slight changes of temperature during an exposure which may last several hours are fatal to work of high precision.

The great height of the tower has one advantage not yet mentioned. Anyone looking along a hot street has undoubtedly noticed how an object near the ground seems to be trembling owing to the intermingling of the unequally heated air currents. An object at some distance above the street does not appear to tremble anything like as much. Hence if we increase the elevation above the earth at which the beam of light is received by the lens and then carefully shield this beam by means of the tube of sheet metal, it is possible to get a much steadier image of the sun than if the beam were received near the ground.

An elevator run by an electric motor is used to make the ascent of the tower for opening the dome and setting the mirrors before beginning observations. A ladder is also provided should the elevator be temporarily out of commission, but it goes without saying that the elevator is the more popular of the two.

Electric motors are used to control the movements of the various instruments, the switches being as far as possible directly under the observer's hand. Most of the motors are of the reversible type, as double motions are usually necessary. Eighteen motors are required for the various purposes.

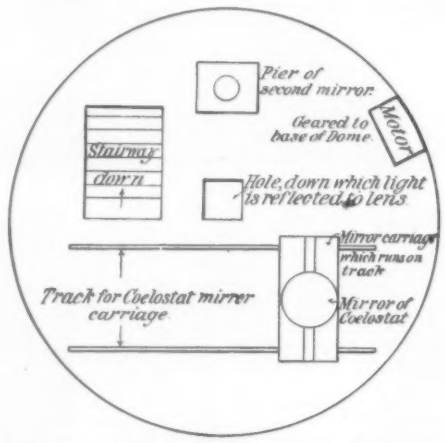

Pier of second mirror
Geared to base of Dome
Motor
Stairway down
Hole, down which light is reflected to lens
Mirror carriage which runs on track
Track for Coelostat mirror carriage
Mirror of Coelostat

Fig. 6.—Top plan view of the tower and its apparatus.

The great instrument thus briefly described has just been completed. In the hands of Dr. Hale and his coworkers it will undoubtedly greatly aid in solving many of the troublesome problems in solar physics.

Acknowledgments are due to Mr. Ellerman and Mr. Messer of the observatory staff for the excellent photographs used to illustrate this article.

Crop Improvement: A Problem in Increasing Our National Efficiency

By C. M. Carroll

IT is generally conceded by those who know, that science is twenty-five years in advance of its practical application. Unfortunately this lamentable fact applies also to the science of farming, which is our primary base of supply. Since the superstructure of commerce is builded upon a foundation of agriculture, commercial development is the logical sequence of agricultural development. Soil, therefore, it seems, always was, and never has ceased to be, the world's principal asset. No one has even attempted to dispute it. Since commerce is simply an interchange of commodities which are produced from the soil, business men cannot say, "Why should we bother our heads about the crops? Let the farmers take care of their own business and we will take care of ours."

"Mind your own business" is an excellent motto, but, so few of us really know what is our own business. Agriculture is so interwoven with the business of us all that it is impossible to find the line of cleavage where one man can say, "This is my business, let me alone."

We are all of us convinced that it is immediately necessary to add to our national wealth by getting more out of the soil. Farming is everybody's business, and woe to the man who says that he is not concerned in the business of farming. We have been carrying no grain surplus, and a single crop failure would put us on almost a famine basis. The United States, from year to year, is becoming less considered in the feeding of other nations, and we are rapidly drifting to the point where the balance of trade will be permanently against us. How are we going to regain the money spent by our tourists abroad, the interest on our bonds and the vast sums which are expended for diamonds and luxuries from every part of the world?

When we look at the ten-acre plots of Europe and behold a larger yield than from a forty-acre American field, we feel that our millions of farmers are in reality no farmers at all; and with the exception of here and there a man who is tilling the soil with thrift and intelligence, the great majority are still robbing the land, and getting less than half of the crop.

In 1910 there were two hundred million acres of wheat, corn and oats harvested in the United States. Our agricultural scientists tell us that we can increase any crop from four to ten bushels per acre in a single season by seed selection and proper cultural methods.

In spite of the excellent and energetic work of the United States and State Departments of Agriculture, the agricultural colleges and extension departments, farmers' institutes, and a thousand other things which are being preached by the agricultural press, the unpleasant fact still remains that twenty years ago the United States raised more than six hundred million bushels of wheat which is about the same amount raised in 1911, while our population has increased nearly thirty million souls.

Notwithstanding our enormous activities, the average yield of corn per acre is slightly more than thirty-four bushels. Prize corn growers have demonstrated that it is possible to grow two hundred and twenty-five bushels to the acre. The price of flax seed is soaring all out of proportion, and barley is selling for $1.25 per bushel, for a very poor grade at that. The cost of living is not so high in this country, but it will be higher in the near future if the present tendencies continue. It is common knowledge that vast areas of land in the original thirteen States now lie abandoned. Many farms of the Middle West States are now undergoing rapid soil depletion as a result of careless farming.

Quoted from eminent authority, "The American farmer has learned well the art of agriculture in the hard school of experience, but the science of agriculture is almost unknown to him; and unknown not only to the farmers and land owners, but also unknown to the statesmen, unknown to the local public officials, unknown to the teachers of the common schools, and unknown to the preachers, to the merchants, to the grain dealers and to the bankers."

So it is evident that preaching and the printing of bulletins are not altogether satisfactory.

True co-operation means the greatest good to the greatest number, and upon this basis Bert Ball, secretary of the Crop Improvement Committee of the Council of Grain Exchanges of America, is making an effort to unify and harmonize all of the interests, including the manufacturers of agricultural implements, fertilizers, grain and elevator companies, cereal manufacturers, chemical manufacturers, railroads, bankers, and all other business interests in a National crop improvement plan to co-operate with the U. S. Department of Agriculture and the various branches of the extension department of the State agricultural colleges. Individual effort at cross purposes will not accomplish satisfactory results. The plan covers the development of each county through an amalgamation of commercial, educational, transportation and agricultural interests. It advocates the establishment of trained agriculturists in each of the counties of all of the agricultural States in connection with the United States Bureau of Farm Management, State agricultural colleges, State commercial associations and local commercial clubs.

The National fund for this purpose is now being raised in order to offer $1,000 or more to each county in each State, and State commercial organizations are ready to form State crop improvement associations to raise a like amount to that offered to each county from the National organization. This fund has been started with one million dollars by Messrs. Sears, Roebuck & Co., of Chicago, who have set aside the sum $1,000, to be given to each of 1,000 counties in every State which will raise a fund locally, sufficient to employ a permanent county agriculturist and farm demonstrator.

The Government Bureau of Farm Management also has a fund, and offers to bear from one third to one half of the expense of this Farm Bureau in any county the plans of which are acceptable as soon as its funds become available for this year. This will add approximately another $1,000 to each county ready to raise its own fund.

While there are scarcely any two counties operating under exactly the same plan, the following is the one recommended by the Crop Improvement Committee.

First: That a joint meeting be called by the commercial organization or organizations, to which there will be invited editors, railroad men, road commissioners, superintendents of county schools, superintendent of the county farm, the county supervisors (commissioners of county court, as the case may be), bankers, millers, manufacturers, grain buyers, officers of all farmers' and breeders' organizations, the leading farmers and land owners in each township. This meeting to be conducted by a member of the Crop Improvement Committee of the Council of Grain Exchanges, explaining the nature of the movement.

Second: That a committee on crop improvement and county development be appointed by the president of the commercial club: that the members of this committee shall act ex-officio as chairman of the sub-committees on ways and means, membership, grain, good roads, marketing, agriculture in the schools, dairy inspection, landlord and tenant, etc.

Third: That a special section be added to the constitution and by-laws of the commercial club providing for an agricultural membership at a nominal fee per year, in order to obtain a widespread special membership, placing the farmer upon a business basis, establishing him as a business man among business men.

Fourth: That the sum to be raised in each county should equal annually one cent per acre of all the tillable land in the county, or a minimum of $100 to be subscribed by farmers, landowners, elevators, country merchants, professional men, blacksmiths, hotels, etc., in each township.

(Section Four, like the whole plan, is elastic, and may be changed to fit local conditions.)

Fifth: That an equal amount be contributed by the commercial club, merchants, manufacturers, bankers and business interests of the country which shall not be less than a minimum of $100 for each township in the county. This divides the financial responsibility equitably.

Sixth: That a trained agriculturist of business tact and judgment shall be employed by the committee as above set forth, who shall be recommended by or satisfactory to the State College of Agriculture.

That this man shall be responsible to the local committee, according to the terms of his contract.

That he shall be employed for not less than two years, and preferably for three years.

That the commercial club shall establish an office for him in a suitable location, preferably with the commercial club.

That he must submit his plans to the local committee from time to time and report the progress of his work, a copy of which shall be furnished to the newspapers in the county, with a request that they be printed in advance.

His duties shall consist in general as advisor to any farmer in the county requiring his services; to organize farmers' clubs; to conduct corn clubs and other agricultural contests; to arrange for exhibits of agricultural products; to give practical demonstration and instruction in crop rotation, soil building, farm management, and horticultural work in various parts of the county under ordinary conditions; to co-operate with the State Agricultural College and the superintendent of county and city schools as well, in teaching the rudiments of agriculture, particularly of seeds, so that the children may ultimately test all of the seeds to be planted on each farm in each school district.

That the children of the public schools shall be furnished with crop report blanks between harvest and seeding time, and each pupil be induced to obtain a written statement upon these blanks by a different farmer stating the number of acres devoted to each crop and the annual yield as per directions furnished.

That these reports shall be classified and the results tabulated and published by the committees in charge, the object of which is to learn not only the total yield of the county but how much each individual adds to the total.

Seventh: That the manager lay out a practical schedule of farm practice for the county poor farm which shall be acceptable to the county supervisors, with a view of putting the farm on a self sustaining basis. It shall be his duty also to establish seed plots, both on the county farm and in the various parts of the county on private farms to breed up to the highest efficiency the variety of seed wheat, corn, oats, barley, rye or other products which may be best adapted to the soil and climate of the county, so that eventually a single uniform variety and grade of each grain may be established which may be shipped in carloads free from mixture of other grains and the seeds of noxious weeds.

Eighth: While it is not incumbent upon the local committees or of the manager of the county farm bureau to put all of these recommendations into immediate practice, it will define a line of procedure which will enable the county committee and Crop Improvement Committee of the Council of Grain Exchanges to make a satisfactory agreement.

The International Electrotechnical Commission

APROPOS of the general meeting of the International Electrotechnical Commission held at Turin in September, the London *Times* publishes a review of the valuable work which the commission has taken up since it was organized, in London, in 1906. Up to 1908 only ten countries were active adherents, but now twenty countries are taking part in the proceedings.

An unofficial meeting of the commission was held in Brussels last August, under the presidency of Prof. Eric Gerard, at which much progress was made toward the solution of many problems upon which international agreement had become an increasing necessity. One of these was the establishment of international symbols for the various electrical quantities. The Elektrotechnischer Verein, of Berlin, which represents all German-speaking countries, having adhered to the recommendations of this meeting, it is altogether probable that at Turin the symbols I, E, and R, familiar to English-speaking physicists, will be universally accepted for the simple representation of Ohm's law.

It is also expected that international agreement will shortly be reached as to the rating of electrical machinery, i. e., the tests to which such machinery must conform before being put to actual use.

A small international committee, which met at Cologne last May, has made a substantial beginning in the matter of industrial electrotechnical terminology in French and English, the official languages of the commission. The committee agreed to some fifty industrial terms and definitions.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Compressed Air to Prevent Foundering

To the Editor of the SCIENTIFIC AMERICAN:

Your daily mail now probably contains hundreds of letters setting forth impossible and impractical ideas of what should have been done to have made the "Titanic" really unsinkable.

I presume an idea I advanced in a letter to you over twenty years ago is an impractical one, or it would have been adopted in some form before this.

The idea was to connect each water-tight compartment through an opening in its upper part or ceiling with a powerful air-compressing plant. A few moments would suffice to give any broken compartment an air pressure that would prevent water rising above the break in its side. If your picture in this week's paper is correct, this plan would have kept her afloat.

North East, Pa. A. I. LOOP.

A Plea for Wireless Investigation

To the Editor of the SCIENTIFIC AMERICAN:

The public has recently been agitated by the failure of the papers to get news of the "Titanic" disaster. A reason had to be given the public for this delay. The blame was laid to the parties least able to defend themselves, as is usually the case. At once great headlines flared forth the atrocities of the "Wireless Meddler."

To put aside all consideration of causes other than that of amateur interference. let us consider the case of the amateur from his side of the fence.

Who is the amateur—the high school boy or the advanced experimentor? High school boys are not very apt to cause trouble by high-powered sets, nor are the advanced experimentors going to interfere with important messages, knowing as they do how dependent they are upon the good will of the Government stations. The amateur, with a low-powered set and short wave, can be avoided unless the other station is also using a very short wave. Up-to-date commercial sets have long wave lengths, and are able to get rid of the "kids" with satisfaction.

As to the amateur himself, no investigation conducted along sane grounds could be too welcome. The navy and commercial operators are both prejudiced. One would like complete control, the other likes no control at all. Investigation by such a man as Prof. G. W. Pierce of Harvard, or by some other scientific expert of known worth, would lead to regulation of some kind, but regulation that would not be prohibitive to the experimentor. The idea of completely killing all experimentors, which the navy is fostering with care, is absurd to a rational thinker. Yet every means is being turned to this very end. Whenever an operator in one of the Government stations has any difficulty with his apparatus, or misses out on a message through his own inability, a very simple and efficient excuse is, "Couldn't get a thing through the amateurs."

What the amateur wants is investigation, not a lot of operators' opinions, all of which are sure to be distorted, according as they are Government or commercial, but investigation by a third party of known repute, preferably a college expert. Then such regulation as is recommended will be received with satisfaction, at least by those wishing a square deal to all concerned.

Cambridge, Mass. H. E. RAWSON.

In Defense of the Amateur Wireless Operator

To the Editor of the SCIENTIFIC AMERICAN:

I have long been a friend of, and a subscriber to, the SCIENTIFIC AMERICAN, whose fairness, and care in making sure of the truth of statements before publishing them, has especially appealed to me. It is with much regret, therefore, that I note the unfriendly attitude taken by you toward the independent wireless experimenters, and am sure that this attitude would be quickly changed if you had a wireless station of your own, were familar with practical operating, and heard with your own ears what is actually going on in the ether, as I do every day. With the equipment at my station I am able to hear the Government and commercial stations, and ships along the coast, all the way from Portsmouth, N. H., to Key West, and the facts revealed by listening to what is going on in this wide field are these: The commercial stations and ships are constantly operating, receiving, and sending messages at high speed, and usually without trouble or repetition. One can listen to them night after night, without hearing a case of interference.

The naval stations operate at an average speed of about twelve words a minute, and it is the exception rather than the rule for one of them to receive a message without having it repeated in whole or in part.

One night recently a friend and myself were listening in (using two sets of phones in series) and heard Baltimore send a message to the Washington navy yard, which we received without difficulty. After some time the navy operator said: "Please go ahead a little slower;" and Baltimore thereupon repeated the message slowly in perfect Continental. The navy yard then got part of it, but asked him to repeat a portion of the middle. This time the navy operator got a word or two more, but had to have the message four times before he got it all. No other station was sending at the time, and there was very little static. On another occasion the navy operator at Norfolk, after trying several times to get a message through to Washington at a rate of about five words a minute, gave up in disgust, and said: "For the love of Mike, get an operator." On still another occasion, after the naval station at Annapolis had made several futile attempts to receive a message, the navy yard here broke in and said: "Say, old man, send it to him slow." This was done with better results.

A dozen pages might be filled with similar incidents, which are true, to my personal knowledge. It is also true, as your correspondent, Mr. Powell, states, that private wireless stations here often copy messages which the navy yard is unable to receive. I know this to be a fact, for I have done it myself.

In view of this condition, it is possible to understand how such statements as yours of the front page of the issue of March 23rd came to be published. The Government operator, an amateur himself, fails to receive a message, and an explanation being demanded by the officer in charge, he must have an excuse or get into trouble; therefore, he says that amateur stations interfered with him.

The difficulties the "Titanic" had in communicating with the "Carpathia" in mid-ocean were explained in this way to the full satisfaction of newspaper editors; and Siasconset wireless station could do nothing for forty-eight hours, though situated far out at sea, with nothing near but a fishing hamlet!

The latter case calls to mind the letter from Donald P. Beard, published in your issue of May 4th, and it is hard for one conversant with the facts to restrain his indignation upon reading such a letter. The writer hints that the suppression of private wireless stations would secure secrecy. He is evidently unfamiliar with the fact that any operator can connect his instruments between his iron bed and the radiator in his room, and receive messages from stations hundreds of miles away. I know this can be done, for I have done it. The only possible way to prevent "interference" of this kind is to have a Government inspection of every room in the United States. We recommend this to the attention of your Missouri correspondent! As for that writer's statement that the Government equipment is of the "most advanced and delicate type," it is quite evident that he has never compared an old outfit, such as the navy yard here has, with a perfected apparatus like the recent multiple tuner now in use in Marconi stations.

Mr. Powell was absolutely correct in his statement that the listening amateur operators insure the receipt of distress calls, and thus constitute a great safeguard. I believe in this from the large number of calls that are never heard by the Government and commercial stations. While experimenting with my receiving set at a point on Buzzards Bay, Mass., I once heard a ship call every naval and commercial station from "N. A. G." (Fire Island, N. Y.) to "B. H." (Boston), inclusive, also several ships, for an hour, without getting a reply. *Suppose this had been an urgent distress call?* That ship would have gone down with the call unanswered unless I or some other "meddler" had given the alarm.

This does not necessarily mean that the regular operators were neglecting their duty. Some may have taken off their 'phones to rest, and others may have been "listening on a different tune." But it *does* demonstrate that the only safety lies in having as many operators as possible on the job.

While a complete defense of the wireless amateur operator, or a technical explanation of why such stories as that of Siasconset and Gresham interference are untrue, cannot be made within the bounds of one letter, the writer hopes that the foregoing facts will have some weight with the Editor of the SCIENTIFIC AMERICAN. They were not obtained second hand, or from newspaper report, but are true, to the personal knowledge or the writer, who is a credible witness, and will be pleased to testify to them under oath.

Of course, no one can deny that it is possible for a private wireless station in the vicinity of a Government station to interfere with the latter, and this interference sometimes takes place, and therefore some form of regulation by law should be had; but it would seem to the writer that the law need only provide for the licensing of such private stations as are near enough to the Government stations to be actually capable of interference, thus leaving thousands of those which are back in the country, and cannot interfere, free to operate and develop the new means of communication unhampered. Would the SCIENTIFIC AMERICAN give its support to such a bill?

JOHN V. PURSELL.

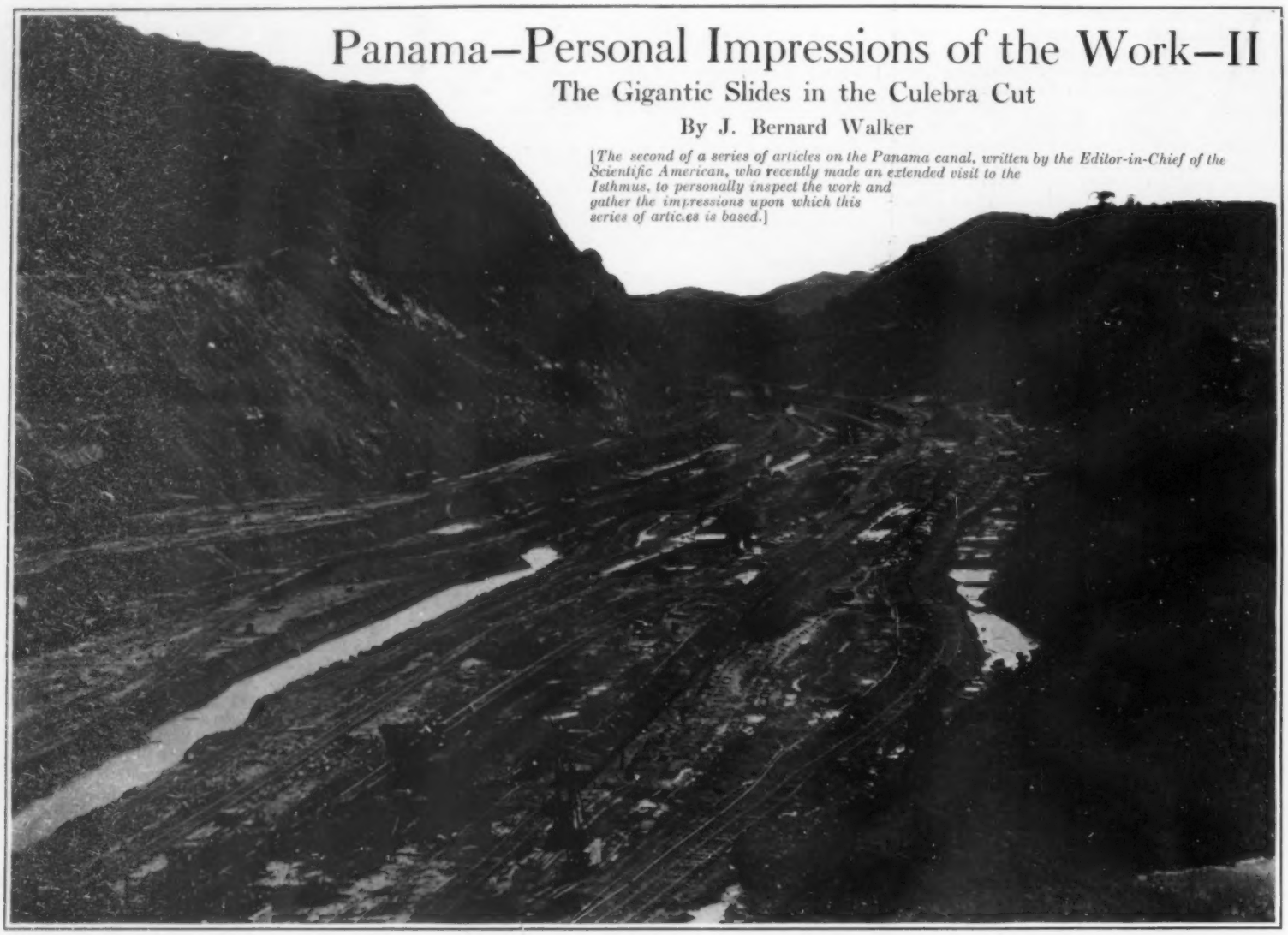
Tennallytown Station, Washington, D. C.

Panama—Personal Impressions of the Work—II

The Gigantic Slides in the Culebra Cut

By J. Bernard Walker

[The second of a series of articles on the Panama canal, written by the Editor-in-Chief of the Scientific American, who recently made an extended visit to the Isthmus, to personally inspect the work and gather the impressions upon which this series of articles is based.]



This photograph shows the deepest point of excavation, which occurs at the summit of the mountain divide. The highest point of excavation is at the top of Gold Hill on the left, 534 feet above the sea level.

The Culebra cut at Gold Hill.

MANY of us will remember that when the United States entered upon the work of constructing the Panama canal, the most formidable obstacle, and the one which it was believed would control the question of the date of completion, was the great cut through the continental divide at Culebra. It was confidently predicted that the other more important works, such as the Gatun dam and the locks, would be completed well ahead of the stupendous excavation which had to be laboriously carried through the mountains. The question of how soon the canal could be completed was assumed to be a question of how soon the great cut could be opened down to grade.

But when the full strength of the American machinery and working force had been developed at Culebra, and the steam shovel had begun to bite deeply into the work, the progress was at such an astounding rate that it soon became evident, barring unforeseen accidents, that the cut would be completed ahead of the Gatun dam or the locks. Thus it came about that the determining time-element was for some years considered to be the laying of the enormous masses of concrete in the locks and the slow upbuilding of the artificial hill across the valley of the Chagres at Gatun.

Nature, however, had in store for the American toilers some unsuspected difficulties, or, to speak more correctly, difficulties on an entirely unsuspected scale. Slides of a magnitude unprecedented in the history of engineering began to develop, and the deeper the excavation went, the more formidable were the slides. Before many months had passed it began to be a question whether, after all, Culebra cut would not be the last of the work to be accomplished. As the cut was carried down and the slides increased in magnitude, the question developed into a certainty.

Before proceeding any further, let it be clearly understood that the slides, in spite of their stupendous proportions, will have no effect in delaying the opening of the canal. They are troublesome, their ultimate extent is somewhat uncertain, and they are enormously costly; but no one on the isthmus who has any technical knowledge of the situation believes that they can possibly become so extended as to delay the date of opening.

Now, although the cut through the divide is approximately nine miles in length, the bulk of the work of excavation is concentrated at the point where the highest ridge of the hills is cut through, and it has been done within the comparatively short distance of about five miles. So heavy is the work that within the limits of two miles in the vicinity of Gold Hill the total amount of excavation will reach the enormous figure of 56,500,000 cubic yards. The deepest excavation is at Gold Hill, where a cross-section shows that the highest point of excavation (where ground was broken by the French) on the eastern side of the cut, is at an elevation of 534 feet above sea level, or 494 feet above the bottom of the excavation. At the center of the canal, at the axis of the present canal prism, the original surface of the ground was about 300 feet above sea level or about 260 feet above the finished bottom of the canal. The highest point of excavation on the west side of the cut is 312 feet above the sea level.

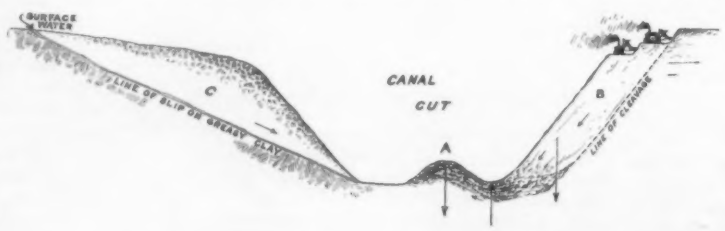


Diagram showing the action of slides in the Culebra cut.

The French appeared to have recognized that the excavation through the Culebra divide was the most important part of the whole work at the isthmus; although they were also fully alive to the fact that the proper control of the Chagres River was essential to the success of the canal.

When the excavation is completed the bottom of the canal will be at elevation plus 40 above mean sea level. It will be filled with forty-five feet of water, so that the elevation of the surface will be normally at plus 85 above mean sea level. At the end of the rainy season, the surface of the canal through Culebra and of Gatun Lake will be at plus 87, the gates at Gatun spillway being arranged to hold it at that maximum elevation. During the dry season the loss of water due to passing ships through the lock, evaporation, leakage, etc., will gradually lower the surface level; but since it will be possible to carry on navigation with about 41 feet of water in the canal, there will be stored for the dry season a surplus of more than five feet of water.

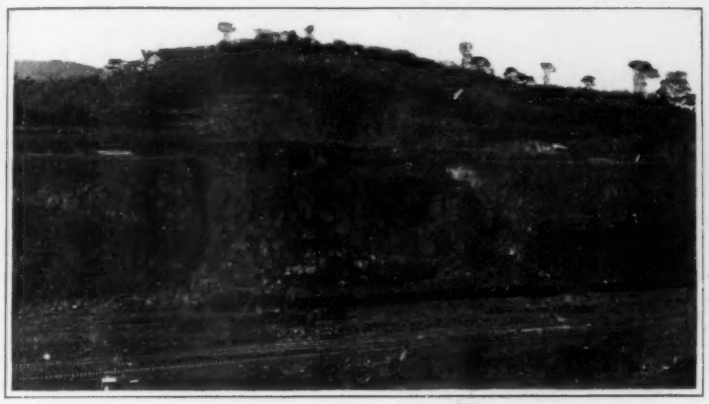
One of the first impressions I received during my study of the work and the men who have it in hand was that of the generous tribute which is universally paid by American engineers to the quantity and character of the work done under the French *régime*. Twenty-five years ago excavating machinery was almost Lilliputian compared to that which the contractor has ready to hand to-day. The French employed the most up-to-date methods of their day; and more than once the engineers in charge of the work stated to the writer that, considering the difficult and novel climatic conditions under which they worked, and the limited capacity of the excavating plant of those early days, the French did some exceedingly creditable work.

But as far back as the year 1884 there loomed up a little cloud of trouble which was destined to grow amazingly and prove to be one of the many discouraging elements which led to the collapse of the French plans. At Cucaracha, on the east side of the canal, just to the south of the solid rock formation at Gold Hill, there developed a slide which continued throughout the French period, and was destined to extend into many years of the American occupation. This slide has broken back nearly two thousand feet from the center line of canal, and has extended over no less than 47 acres. Up to July 1st of last year, 2,722,164 cubic yards of material had slid into the cut and been removed, and at that time it was estimated that 400,000 cubic yards remained to be taken out.

Twelve months ago there were twenty-one slides in the length of the Culebra cut. Of these, twelve covered areas which varied from one to forty-seven acres,

A ninety-five ton shovel buried in a rock slide.

Two traveling cranes rescuing a steam shovel from Cucaracha slide.



This is a typical break, in which there is a vertical line of cleavage and the bottom of the detached mass crumbles under the weight of the superincumbent material.

Slide at Paraiso.

The weight of the sliding mass on the right has forced up the small hill or "hump" which is seen in the center of the canal excavation.

The great Culebra slide to the north of Gold Hill.

and the other nine were of less than one acre in extent. At that time the total area of the material that was moving down into the cut was 149 acres! At the present writing over 15,000,000 cubic yards of sliding material has been loaded on to cars and hauled out to distant dumping grounds. Some of the slides, including that of Cucaracha, have ceased movement and are "dead." Others are still in movement.

The slides are due to the irregular geological formation of the Isthmus. The material through which the canal is being dug consists largely of a sedimentary volcanic ash, which in the course of its geologically immature life has solidified to varying degrees of hardness. Rarely is it found of the proper hardness and consistency to be entitled rock, in the sense of that word as employed in engineering work in the United States. This material is here and there upheaved and penetrated by a hard and stable igneous rock such as is found at Gamboa and notably at Gold Hill. The great irregularity both in the stratification and the consistency of the material, particularly where it rests on harder, underlying rock, presents conditions, when the material is disturbed by excavation, eminently favorable for the formation of heavy slides.

Broadly speaking, the moving mass comes down into the cut either by sliding or by crushing. In some cases, the material has been sloped at a deeper angle than that at which it can naturally stand, and in such a case it will keep slipping off until the natural angle of repose has been reached. In many cases, equilibrium is not established until the slide has reached a slope of 1 vertical to 7 horizontal. Another form of sliding occurs when the overlying material through which the cut has been made, is resting upon rock or some harder material than itself which slopes toward the excavation. As the excavation is carried down, the overlying mass becomes so heavy as to overcome the frictional resistance between itself and the harder material beneath, and it commences to move into the excavation. The movement is frequently assisted by surface drainage water, which, filtering along the natural line of separation, lubricates the surfaces and assists the movement.

Another form of slide is that which is due to crushing or disintegration of the material. This occurs when the underlying rock is of poor quality or is intersected by vertical seams or seams which slope toward the canal. As the depth of the excavation increases, the weight of the superincumbent mass along the face of the cut becomes so great that the material at the foot of the excavation is crushed; it loses its cohesion, breaks up, and is pushed down and outward toward the center of the excavation. Being resisted by the reactive effect of the undisturbed floor and opposite foot of the cut, the material is forced, sometimes, as high as twenty to thirty feet above the original bottom of the cut. The "hump," as it is called, at *A* (see accompanying sketch) rises until a point is reached where an equilibrium is established between the weight of the hump and the weight of the sliding section *B* of the side of the cut, less the frictional resistance to movement along the line of cleavage. The method of dealing with these slides adopted by Col. D. D. Gaillard, who has been in charge of the Central Division, in which Culebra is included, for the last

(Concluded on page 526.)

From the plough on the last car, a steel cable extends to a steam winding drum at the engine. The plough is drawn forward, sweeping off the contents of each car, and so speedily unloading the whole train.

Plough unloading a dirt train of twenty flat cars.

Wilbur Wright

The Passing of a Great Inventor

MISUNDERSTOOD though he was in the early stages of his experimental work, carried out in collaboration with his brother; unappreciated at first even by his own countrymen, Wilbur Wright, in the brief space of nine years, saw the flying machine develop under his hands and those of his brother from a crude gliding mechanism into a great, motor-driven artificial bird; lived to see the realization of a dream that has haunted inventors ever since the world began; lived to see himself honored by kings and potentates, legislators and scientists, statesmen and artists the world over. Hundred years hence, it may be, the conquest of the air, attended as it has been by the disheartening defeat of hundreds of misguided men and the sacrifice of many lives, will be deemed of less material importance than the invention of the telegraph or the introduction of Bessemer steel. Yet if we measure the significance of navigating the air in an aeroplane by the difficulties which have accompanied the building of the really first practical heavier-than-air machine, who will deny that Wilbur Wright must be accorded the honor of standing in the annals of invention beside Morse, Bell, Fulton, Bessemer, Watt, Arkwright, in a word, beside the men who have given us the machinery of modern civilization?

His was indeed a singular personality. Lean, angular, reticent, he had nothing of the outward brilliancy that one would associate with the solution of one of the most difficult mechanical problems that ever confronted the human mind. Scientific training in the accepted sense of the term, he had little. Yet his whole bent of mind, his whole attitude toward the invention with which his name will be forever associated, was essentially scientific. He never boasted. Like a true scientist, he stated the facts almost as colorlessly as if he were expounding a mathematical formula.

Yet scientific aid he and his brother certainly received from the late Octave Chanute, that noble-minded pioneer who gave so generously out of his ripe experience. It was he who introduced the two brothers to the scientific world by inducing them to read a paper, now historic, before the Western Society of Engineers; it was he who watched their initial experiments, and he who vouched for their success at a time when the world was still in doubt.

When the news was first flashed around the world that two bicycle makers of Dayton, Ohio, had invented an aeroplane with which they had actually been making more or less public flights, no one would believe it. It seemed incredible that the American newspaper reporter, who had been known to climb down chimneys in the effort to pry into the affairs of other people, had allowed so important an event to pass unheralded for months, and still more incredible that the first practical flying machine should have been invented by two obscure mechanics of the Middle West. Had not Maxim spent $125,000 on the problem and given up its solution as an impossibility? Had not Langley, after years of experimenting, been compelled to abandon his work because the Government refused to assist him further? Had not Lilienthal and Pilcher lost their lives in gliders? Later, when the reporters began to appear and the too curious public became uncomfortably numerous, Wilbur and his brother retired to Kitty Hawk, on the inaccessible sand dunes of which they had carried on their early work. Photographers, hidden in bushes, brought back tiny views of an aeroplane in the air—the first evidence of the flying machine's advent, but not evidence of the real construction of the wonderful machine. Not until 1908, when Orville in America, and Wilbur in France, performed the first really public flights in pursuance of contract obligations, was the construction of their machine really understood.

Like all great inventions, it proved amazingly simple. There was the trussed frame that Chanute had first used with such success; there was the horizontal rudder, placed forward as Maxim had done; there was a means of controlling the lateral balance by changing the impact angles of the wings, a method proposed years before; there was the vertical rudder obviously essential for directing the machine in a horizontal plane; and there were the sled runners that Ader and others had proposed. Not a single element in the machine was absolutely novel; yet the machine as a whole was the most novel mechanism that could be imagined. The same may be said of every great invention. Morse, Bell, Fulton and the rest, all of them seized the abandoned devices of their predecessors and combined them into operative inventions. To the world at large it seems but a small thing to step in this manner from failure to success; yet only a master mind succeeds in making an operative combination out of old elements. In an appreciation such as this, it is out of place to comment upon the originality of the two brothers who gave us the flying machine. Some day, when a real history of the art of flying is written, when the legal bickerings that now befog the issues are well behind us, it will be realized that the invention of the flying machine differed psychologically in no important respect from the invention of other great mechanisms; that invention always consists not in dreaming, or in writing reams of paper on possible ways of flying or in drawing countless designs of possible operative soaring devices, but in doing, in ceaselessly experimenting, in risking health and life.

Photograph by Hollinger.

WILBUR WRIGHT

It is not without significance that the flying machine should have been developed, not by an engineer or a trained physicist, but by two men who worked with their hands. Thus the popular conception of the true inventor is justified, and thus the stories of great inventions is enriched by still another tale in which the hero is not a university professor or a member of the Royal Society, but a simple, yet wonderfully ingenious man who patiently works by cut-and-try methods and succeeds.

That Wilbur and Orville Wright should fashion their machine with their own hands, that they should make even their own motor, conforms with the traditions of invention. Every strut, every wire, every piece of spruce that entered into the machine's construction was manipulated by the brothers themselves.

A sportsman in the true sense of the word, Wilbur Wright was not. By that we do not mean that he was totally incapable of enjoying the pleasurable side of flying. That he experienced all the thrill of a flight through the air, he gave ample proof in a brief article written by him and his brother for the SCIENTIFIC AMERICAN some years ago. But a sportsman in the sense that he loved to pit machine against machine for the mere sake of racing, regardless of personal risk, he was not and had no desire to be. He never placed his own life in jeopardy more than the exigencies of flying ordinarily demanded; nor would he or his brother permit the aviators in their employ to do so. No man realized more keenly than he how enormous is the personal risk involved even in ordinary flight; no man took such precautions as he to mitigate those risks. The meticulous care with which he examined every square inch of his machine before each flight, must have seemed ridiculous to those who watched him and who fancied that flying was no more dangerous than automobiling. The need of care, too, seemed belied by the matter of fact way in which he made his personal preparations. He never troubled to don an elaborate flying garment; he wore no goggles; he made none of those theatrical preparations which the public has come to expect of the airman. He slipped a pair of bicycle clamps around his trousers, pulled his tourist cap farther down on his bird-like face, and placed his hands on the levers. That was all.

Supreme self-confidence and yet not a trace of vanity was one remarkable characteristic. Deeply religious, too, he was, a trait which is to be expected of the son of a bishop and the descendant of Puritans. He carried his religious beliefs far. He himself never took part in a flying contest on a Sunday nor would he permit his aviators to do so. At Belmont Park and at other meetings he was perfectly willing to lose thousands of dollars on that account alone. He never spoke or wrote of his work without mentioning his brother. For that reason it is difficult—we have found it impossible—to write of him alone.

The Gould-Scientific American Prize

ON June 1st the following entries were received for the $15,000 prize offered through the SCIENTIFIC AMERICAN by Mr. Edwin Gould for "the most perfect and practicable heavier-than-air flying machine, designed and demonstrated in this country and equipped with two or more complete power plants (separate motors and propellers), so connected that any power plant may be operated independently, or that they may be used together:"

Alleas Aeroplane Company, Boston, Mass.: Double biplane of the following-surface type.

Howard Gill, Boston, Mass.: Biplane.

H. Curtis, Manchester, Mass.: Burgess biplane.

The Boland Aeroplane and Motor Company, Rahway, N. J.: Biplane.

Edward J. Elsas, Kansas City, Mo.: Biplane.

H. W. Mattoni, 217 West 120th Street, New York: Multiplane.

Macleod Multiplane Company, Richmond, S. I.: Multiplane.

Charles H. Burleigh, South Brunswick, Maine: Multiplane.

George W. Beatty, Mineola, Long Island: Biplane.

Grover Cleveland Loening, on behalf of the Queen Monoplane Company, Fort George, New York: Monoplane.

John P. Conkling, 125 East 23rd Street, New York city: Biplane.

According to the conditions, the contest will take place on July 4th, 1912, and following days under the supervision of a committee which will consist of a representative of the SCIENTIFIC AMERICAN, a representative of the Aero Club of America, and the representative of some technical institute. The place of holding the trial is to be determined by the Contest Committee. The SCIENTIFIC AMERICAN will immediately proceed with the necessary arrangements. The entrants will be duly notified where the contest will be held. Illustrated articles on the tested machines will be published in the SCIENTIFIC AMERICAN.

The Laboratory

Some Suggestions for Home Experiment

A Cheap Telescope

By C. C. Kiplinger

IN that admirable work, "Experimental Science," may be found a description of a very efficient astronomical telescope of minimum cost. The modified instrument here described may prove easier of construction and more adjustable than the foregoing telescope.

The long-focus meniscus lens of the original is not always available. A first-class substitute has been found in the partially corrected auxiliary lens of the "Ideal" portrait type, 2½ inches in diameter and of 40-inch focus, obtainable from any mail order house for about two dollars. The eyepiece is of the microscope kind, negative, 2/3-inch focus, and costing $1.50. The objective is mounted in an adjustable brass cell and is very convenient for this purpose.

The telescope body is made of heavy tin, 3 inches in diameter and 40 inches long, on the outside of which a black canvas cover has been sewed. This is then shellacked, giving an elegant finish to the tube. The interior should be blackened with dead black varnish, or lined with black paper or thin cardboard coated with a mixture of lampblack and glue. The ends of the body should be cut squarely. A suitable stand or tripod should be used in connection with the instrument.

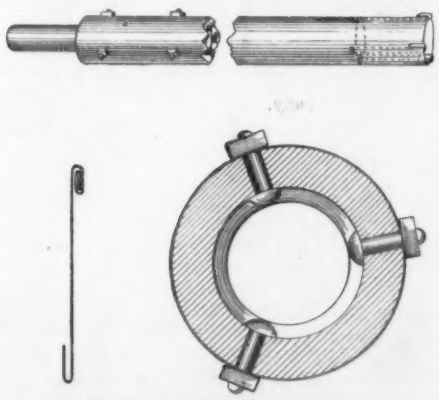
Three strips of tin, ¼ inch wide, should be rolled at one end until about 3/16 inch thick, and lapped over at the other, as shown in the accompanying drawing. These must be equal in length, and serve to hold the objective in position, as indicated by the dotted lines.

The eyepiece mounting is also shown in the drawing. Six small stove bolts, or bolts obtained from old dry batteries, serve to adjust and hold the tubes concentric and the eyepiece in the optical axis. The inner tube should fit tightly, and is necessary because of the bolt heads. The eyepiece tube slides in the latter, hence it should be lined with cloth. These tubes may be made of brass or heavy sheet metal and are blackened on the inside.

The importance of properly diaphragming uncorrected or only partially corrected lenses cannot be too highly emphasized. A simple experiment will illustrate this. Look at the moon through this telescope, using full aperture, and then diaphragm the objective, using blackened cardboard disks with openings of various sizes. Note the wealth of detail and almost complete disappearance of color which is revealed by the use of the smaller apertures. The smallest diaphragm which will give satisfactory illumination with sufficient detail is the one to be used. This must be determined by trial.

Various celestial objects require diaphragms of different sizes; the fainter the object, the larger the opening necessary for best results. The use of diaphragms is also important in the adaptation of non-achromatic lenses to low-power compound microscopes. By using a very small opening, surprising results are obtained from such unpromising materials.

The objective may be much improved by separating them so that they are about ⅛ inch apart. As the two components are cemented together with Canada balsam, they may be separated in the following manner: The



Details of the cheap telescope.

lens should be taken from its cell by removing the retaining ring (a metallic ring pressed into place to hold the glass in position). The lens is now placed in a tray of warm water, putting a small piece of cardboard beneath it so that it does not come in contact with the bottom, and increasing the temperature of the water until the balsam melts and the lenses slide easily apart.

Remove the residual balsam from the glasses with alcohol and a soft cloth, taking care not to injure their polish. They should be remounted in the original cell, separated by a thick ring of cardboard. The definition will be greatly improved. The magnification of the eyepiece will be increased by removing the front lens.

A Thermo Magnetic Motor and Generator

By E. R. Stockle

THE device described below is an interesting application of a well-known phenomenon of ferro-magnetism, viz., the loss of the magnetic quality of iron at red heat. It will be well before proceeding with a

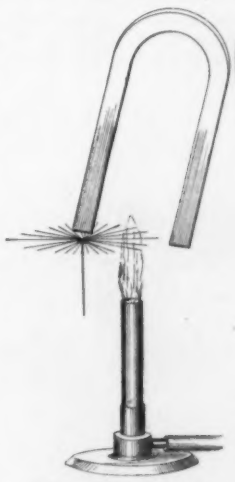


Fig. 1.—The rotating spider.

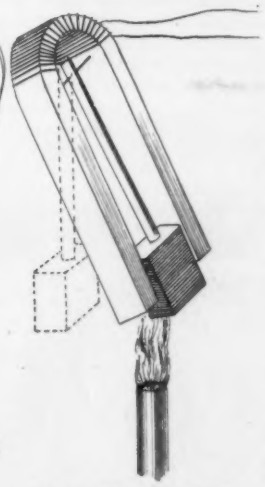


Fig. 2.—An oscillating generator.

description to set forth briefly the manner in which this phenomenon can be employed to furnish mechanical energy, as in a motor, and electrical energy, as in a generator.

Consider the energy expended by a magnet in attracting an iron armature from a distance x to its poles. This energy will be equal to the product of the average force, f, and the distance, x. To remove again the armature to its original position before the poles of the magnet, it is necessary to do an amount of work equal to that given up by the magnetic system when the iron was attracted, viz., $f \times x$. Now the energy for this work can be furnished in two ways. Mechanical energy can be furnished the system by exerting a force, f, and withdrawing the iron to its original position, x. Again, heat energy may be given to the system by heating the armature to red heat, whereupon it loses its magnetic quality, and may be withdrawn the distance x without overcoming any attractive force due to the magnet, that is, without doing any work. Upon the cooling of the armature, however, the heat energy again takes the form of potential energy, because of the restoration of the attractive force between the armature and the magnet. This energy is therefore again available as mechanical energy.

To apply this principle to the operation of the thermo magnetic motor in its simplest form, the following apparatus is assembled:

Several equal lengths of iron wire (about No. 30) are fastened to a needle by a turn or two about its center. These wires are then arranged to radiate symmetrically from the needle, thus completing the "spider" or rotating element of Fig. 1. The needle is then suspended from one pole of the magnet by its point as shown, the ends of the radiating wires just clearing the opposite pole. When a Bunsen burner is placed to heat the wires just to one side of this pole, the cool wires on the other side are attracted toward the pole and into the flame, where they in turn become heated, and give place to other cool wires from the other side of the pole. Thus the rotor may be caused to turn at about 200 revolutions per minute.

Reproducing Engravings Without Light

IF a small steel engraving such as a portrait or a view is treated as follows, an excellent copy can be made direct upon paper or a bright copper plate.

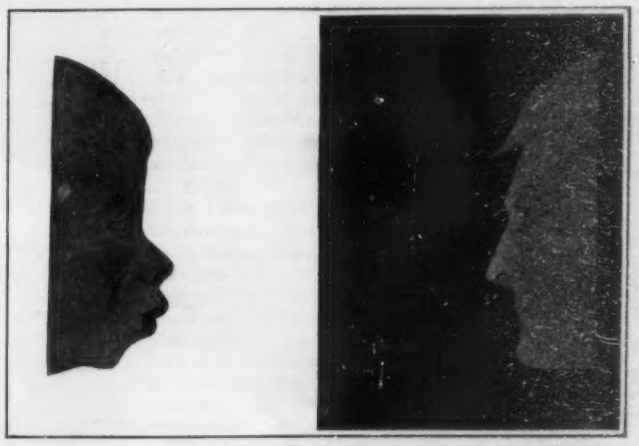
Place fine crystals of iodine upon the bottom of a tray, then place the engraving with the printed face over the iodine for a few minutes. Take a piece of good quality paper that has been starch sized. Moisten it in a solution of water, 8 ounces; sulphuric acid, 2 drops (no more); drain the paper until surface dry; place this upon the iodized engraving; keep the two together under pressure for five minutes, and upon separation there will be found a very fine print (in reverse) of the engraving. Those parts that are black in the engraving will be blue in the print. If this print be now placed upon a very clean smooth copper plate and be subjected to pressure in a copying press for ten to fifteen minutes, the blue image will have left the paper, and an image in iodide of copper will be made upon the copper plate.

If the copper plate is previously coated with silver (electroplated) and the iodized paper pressed thereon, a print in iodide of silver will be formed, which if exposed to the vapor of mercury in a closed box at 120 deg. Fahr., will in a very short time produce a daguerreotype of the engraving. The iodine vapor appears to attack the ink of the engraving only, with the result that a perfect picture can be reproduced both upon paper and metal without the aid of light.

A Light and Shade Illusion

By Prof. Gustave Michaud, Costa Rica State College

A GLANCE at the accompanying figure reveals the ordinary and well-known contrast effect: although both profiles are exactly of one and the same shade of gray, that on the white field looks a trifle darker than the other. The figure, however, was made for the production of an illusion by far more intense and more interesting than this. To get it, turn your back to the window and look at some far-away object in the room. While so doing, without making any effort to see distinctly the obstacle which appears on your line of sight, bring the figure at about one foot from your eyes, when you will notice that the white man's face grows almost white, and the negro's nearly black.



The Negro and the Caucasian faces are of exactly the same tint.

The author is unable to give an entirely satisfactory explanation of this illusion, but its production is doubtless closely related with Jurin's experiment and with what is called Fechner's paradox. Jurin found that any object seen with both eyes seems one-thirteenth more luminous than if seen with one eye only. Fechner discovered that if while one object is being examined with both eyes, the amount of light received by one of the two eyes is decreased through the interposition of a dark glass, the object appears darker than when the whole amount of light received by that eye is suppressed. During the experiment described here, diplopia or double vision occurs as a result of the fact that the eyes are looking afar while the figure considered, and indistinctly seen, is near. As a consequence of diplopia, homologous or corresponding points on the two retinas do not perceive similar images. While the image of the negro's face is formed on the retina of the left eye, that of the dark field is formed on homologous points of the retina of the right eye. Through the curious influence exerted by one eye upon the vision of the other, the face appears much darker than it is. The exact reverse phenomenon takes place in the case of the right eye; when the gray image of the white man's face appears upon the right retina, the homologous points of the left retina perceive the image of the white field. The experiment differs from that of Fechner mainly in the method applied to modify the amount of light admitted, and in the fact that, while the vision of one eye is darkened, that of the other is brighened.

What Inventors Are Doing

Simple Patent Law; Patent Office News; Inventions New and Interesting

Laundering Paper Currency

THE life of a one dollar bill is about fourteen months; at the end of that time the bill which has left the Treasury in crisp, well-starched condition returns so filthy and worn that it must be put through a macerator and completely destroyed. It has cost the Government one and one-third cents to make that bill and to this must be added two mills to pay the cost of destroying the bill. So complete is this destruction, that the resulting pulp has no further use, except for the making of souvenirs which are sold for trifling sums to visitors to the Treasury Department. Most of the bills in circulation are one dollar bills, and naturally they receive far harder wear than bills of higher denominations. Five dollar bills, which take next rank in point of number in service, cost no more for manufacture or destruction. Nearly 45 per cent of the bills issued in the year 1911 were of one, two and five dollar denomination. They amounted to 246,172,000 pieces. In the same fiscal year 232,560,071 pieces of paper currency were returned for redemption, in other words, for destruction. The cost to the Government of manufacturing and issuing these notes was more than $3,000,000, and the cost of destroying them, about $400,000.

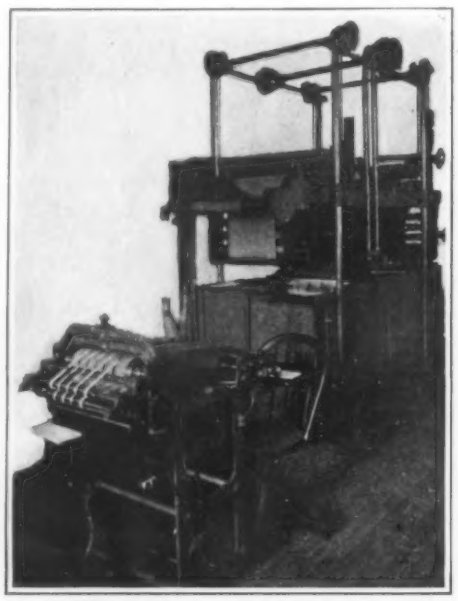
A little over a year ago Joseph E. Ralph, director of the Bureau of Engraving and Printing, suggested to the Secretary of the Treasury that a machine be constructed to launder the old currency and put it in shape for re-circulation. After a year of experimenting, such a machine, or rather, set of machines, was built with a capacity of 20,000 pieces of paper currency per day. These machines wash the bills just as if they were cuffs or collars, starch them and iron them, so that they issue from the laundry looking as good as new. The set which is in operation in Washington is shown in the accompanying engravings. It is proposed to install others in the various sub-treasuries at New York, Boston, Philadelphia, Baltimore, Chicago, Cincinnati, St. Louis, New Orleans and San Francisco. It is also considered probable that the national banks will have to adopt the washer and soon all the principal financial institutions of the country will add a laundry branch to their establishments.

For the present, the Government will not undertake to wash any bills of the higher denominations, which contain yellow ink, for the reason that the potash in the suds in which the bills are washed causes yellow ink to run. However, it is confidently expected that eventually this difficulty will be overcome.

To be properly laundered a bill must go through three separate machines. The first step consists of inserting the bills into the washer, which is made up of a series of rubbers with double blankets between them. Each bill is fed in between these blankets, which hold them flat in the water, and they go back and forth nine times through the suds, which contain a bleach.

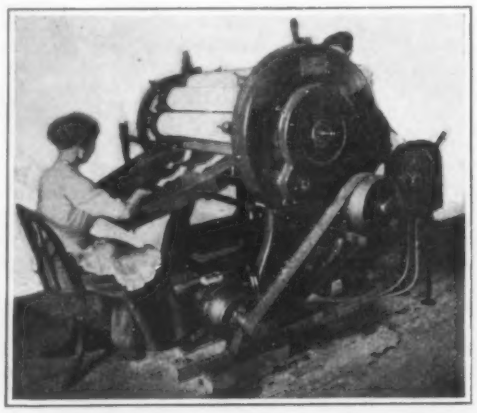
The washing tank is divided into two parts, one of which holds hot suds and the other clear rinse water. The same blankets go up over a partition into the rinse water, carrying the bills with them. After going back and forth through the rinse water eight times, they are blown off the blanket by an air blast which comes through perforated cylinders. Through this washing process, a bill is obliged to travel 150 feet. In order to find lost bills, the washer is raised above the tank and then the suds and rinse water are searched for the bills that have become detached from the blankets and which otherwise would go out with the waste water.

As all the stiffness is taken out of the bill by the laundering process, it is necessary to starch them with a solution of glue and alum. This process is known as sizing the bills. From the sizing machine, the bills go into the ironer, which is an ordinary collar and cuff ironer, such as used in many laundries. The damp sized bills are placed upon a canvas apron and go over a small steel cylinder which dries them, and then over a large cylinder heated to about the same degree as an ordinary flatiron, which irons them. The pressing is done by means of padded rolls. In ten minutes time, and at a cost of but one-tenth of one cent, the dirty bill comes out of the laundry fresh, clean and crisp. Director Ralph estimates that denominations of one dollar, two dollars and five dollars will be laundered at a saving to the Government of $800,000 a year.



The sizing machine and the washer, the latter showing mechanism raised from the rinsing tub.

Sizing the bills before sending them to the ironer.



Ironing the bills on a collar and cuff machine.

LAUNDERING PAPER CURRENCY

How to Remove Lead Sulphate from Lead Plates

By Paul F. Trout

IN storage battery practice, one is often confronted with the perplexing problem of removing a coat of hard lead sulphate from a sheet or plate of metallic lead where it is either undesirable or impossible to remove it by the crude method of scraping. The following is a method which I found to be highly efficient and satisfactory. In this case, the lead plates had become thickly coated with sulphate by precipitation: first, they had been accidentally allowed to stand in distilled water till a thick coat of lead hydroxide had formed, then they were transferred to a bath of dilute sulphuric acid, where a firmly-adhering coat of lead sulphate quickly formed.

First, I washed the acid off in water and then put the plates to soak in a bath of ammonium acetate, ammonium hydroxide and distilled water in these proportions: three parts of water, one part ammonium hydroxide and one part of ammonium acetate—all parts taken by weight.

Second, after the plates were clean they were washed thoroughly and put in a bath of sulphuric acid, specific gravity 1,100; after they had been in the acid bath an hour they were taken out and dried.

The ammonium acetate bath will retain its strength through much work, and when it does begin to weaken, its strength can be maintained for a time by the further addition of ammonium hydroxide.

The operation of washing the lead acetate, a very soluble salt compared to lead sulphate, from the plates prior to immersing them in the sulphuric acid bath must be done thoroughly or the sulphate will re-precipitate, in which case it can however be easily re-dissolved in the ammonium acetate bath.

About four days will be required to completely dissolve a coat of lead sulphate.

Bifunctional Formation of Storage Battery Plates

IN the manufacture of storage batteries of the Faure type it is very desirable to be able to "form" the plates together in sets of positives and negatives—just as they go out in the finished battery ready for the market. A great advantage is gained in "forming" plates together, or "bifunctionally," as it is termed in the trade, because it saves much time and of course money.

But there are many difficulties to be overcome before the method can be carried on with success, and it is the purpose of this article to briefly outline some of those difficulties and to show how to overcome them. First of all, it must be borne in mind that a storage battery in its manufacture and use involves certain immutable laws of nature, as it depends upon electro-chemical reactions to do its work.

To successfully "form" battery plates bifunctionally, one must start at the very first shop operation. Of course, it is taken for granted that care is always taken to secure chemically pure oxides of lead for active material. In the pasting operation is where nearly all failures and troubles have their cause. Pasting is very unhealthy and it is hard to keep good men in that line of work, so, as a consequence, in most shops we find it being done by the lowest type of unskilled workmen who do not know enough to do it right if they tried. Right there lies a potent cause of trouble.

It is most important that the paste be properly mixed and not be allowed to stand longer than a half hour before being used. Distilled water is often mixed with the dry oxide to make a paste, but as hydrolysis is the result to a small degree, its use is not advisable. Where no specially prepared "expander" is available, it is best to use cold sulphuric acid specific gravity 1,100. However, one must be careful in mixing lead oxide and dilute sulphuric acid because heat is produced, which results in a paste which is not chemically uniform. When red oxide of lead is treated with dilute sulphuric acid, it is oxidized to lead peroxide when the acid is either too warm or too strong.

Lead peroxide can be recognized by the light chocolate hue of the mixture, and as red oxide of lead is used on the positive plate whose active material is peroxide of lead, the use of oxidized paste will always produce a plate which will swell or "grow" every time it is "charged" until it will be useless after 8 or 10 cycles of charge and discharge. In battery shops, I have watched pasters mixing red oxide of lead with dilute sulphuric acid, the mixture heating up until steam rose from it, as the acid was too strong and the operation was being carried through too rapidly. I have watched the "forming" of the plates which were pasted with the hot steaming paste and the result was some of the worst cases of "growing" plates I ever saw. It is to the best interests of the manufacturer that the "pasting" operation should not be paid as "piece work." Little harm comes of improper use of paste for negative active material except that the plates will have low capacity. The use of weak sulphuric acid in making paste is all right if it is intelligently and carefully carried on.

Where pure red oxide of lead is used in the positive active material and pure litharge in the negative, "growing" positive plates will always be the result more or less of bifunctional formation, because it does not require as much current to oxidize the red oxide of lead to lead peroxide as it does to reduce an equivalent quantity of litharge to the state of spongy lead. The "Law of Valence" accounts for this fact.

In view of this fact it is very desirable to use something in the positive active material which will have the effect of retarding its oxidation. Litharge has this effect and should be mixed with the red oxide of lead in the following proportion: 75 per cent red oxide of lead to 25 per cent litharge. The two should be thoroughly

mixed together and it will produce a positive plate which will "form" with the same speed and same amount of current as a negative plate pasted with pure litharge.

A great improvement is always found in the finished product when the paste is made by mixing the dry oxide with a liquid "expander" instead of weak sulphuric acid. There are several different "expander" solutions but all serve the same purpose, namely, to cause the active material to swell a trifle during the "forming" charge so that it is slightly porous and hence has a higher capacity. The best "expander" is made by mixing equal parts of chemically pure glycerine and chemically pure sulphuric acid, specific gravity 1,830, and then slowly diluting the mixture with pure distilled water until its specific gravity is 1,100. Great care must be exercised that the temperature of the solution is at no time above 90 deg. Fahr.

Powdered pumice stone mixed into the active material, both positive and negative, before it is made into paste always produces an extra porous plate which will yield very gratifying results on high-rate discharges.

"Expander" made by mixing glycerine and concentrated sulphuric acid according to the above method is used in some of the best storage battery plates on the market to-day.

"Expander" is always driven out of the active material during the "forming" charge so that the swelling effect on the active material always ends when the plate is removed from the weak acid in which it was "formed."

British Patents and Applications

THE British official records for 1911 show that while there was a falling off of over 1,000 in the number of applications for patents there was an increase of more than 10,000 in the applications for designs which were made in 1911 as compared with 1910, the totals for the two years being 43,057 and 32,745, respectively. The designs registered in 1911 aggregated 41,581 as against 32,212 in 1910.

In 1911, 9,743 applications for trademarks were filed and 4,868 registered, as against 10,623 filed and 5,722 registered in 1910.

The Comptroller-General after referring to the ever-increasing importance of means of locomotion to the community in general as demonstrated by the prominence this subject takes under an analysis of the whole field of inventive activity, goes on to say that in the textile industry the most noticeable feature of interest is the remarkable number of inventions designed to obviate the objectionable habit known as "kissing the shuttle;" that is threading the weft by drawing or sucking it through the shuttle eye by the breath. To avoid this, the shuttle is so constructed that it can be threaded by hand, or special suction or other devices are provided for threading existing shuttles. Efforts are still being directed toward abating dust and improving ventilation in the carding room of spinning mills.

Increasing attention is being given to the utilization of the gyroscope, more particularly in its application as a substitute for the magnetic compass, and in its use as an anti-skidding device for vehicles and as a stabilizing means for flying machines.

Only five applications were filed for the revocation of patents worked exclusively or mainly outside of the United Kingdom. In two of the cases the patent was denied, in one the application was dismissed, one case is still pending and in the fifth case the patent expired after the proceeding was instituted.

Notes for Inventors

An Alarm for a Flat Tire.—In patent No. 1,025,100 F. D. Schneider of Bedford, Ohio, provides a simple device easily applied to the spoke of a wheel and having a springy arm which bears at its free end against the side of the pneumatic tire. When this tire becomes flattened beyond the desired point, the arm will be operated each time weight is exerted on that part of the tire against which the arm bears in such manner as to cause the arm to move laterally and sound an alarm. The special form of alarm is a sound box having a convex disk which is buckled by the movement of the arm to make a clicking noise.

The Inspiration to Invention.—At a recent hearing before the Patent Committee of the House of Representatives, a member of the legal profession asserted that inventors are inspired to invention by the rewards which they may obtain. Two inventors followed him and differed with him and with each other. One inventor claimed that a man who is possessed or obsessed by the inventive faculty invents because he cannot help himself; that the inventor who does things worth while cannot help inventing, and he will invent at any cost and at any price until he has finished and put into execution the thought that is in his mind. The second inventor expressed as his opinion that the great, prime stimulus to invention is reputation, the reaching for reputation and the credit for having accomplished something. It is true that both inventors put their art above the mere mercenary money motive and this adds to the interest of their different individual views. But the second inventor qualified his expression by suggesting that while he thinks inventors are impelled principally by the desire to establish reputation for having accomplished something, that if you take away from the inventor the opportunity, deprive him of the opportunity of making a reputation for himself, and deprive him of the opportunity of making any money out of having made the invention, then you strangle the inventive thought, which is, doubtless, very true.

The D. A. R. and Voting Machines.—The Daughters of the American Revolution at their recent convention in Washington city utilized voting machines in the elections. These elections are usually warmly contested and the machines were used this year by the Society for the first time.

Provides for Healing Tree Wounds.—It is always a problem of harvesting sap from trees to protect and heal the wounds to the tree. John T. Gilmer of Mobile, Alabama, in patent 1,012,541, describes a method of treating trees for extracting the sap, such as turpentine, by so boring the bark and the sap wood of the trees as to form passages for the sap, that upon the removal of the sap collecting device from the tree, the outer ends of the passages will be closed by the growth of the bark layer over such passages.

Inventions of a Japanese.—Tetsusaburo Watanabe of New York city has secured four patents, Nos. 1,026,009 to 1,026,012, inclusive. The first and second are for fountain paint brushes and the third for a reservoir attachment for writing pens. The fourth, No. 1,026,012 is for a device for stopping runaway horses and includes means in the nature of side bars to be drawn toward each other to compress the horse's mouth and blinders which can be moved toward each other to cover the horse's eyes, reins being provided in connection with such parts to operate them at the will of the driver

Cotton-chopping by Machine.—You may ride a long way in the cotton country without seeing any cotton-chopping machines in use but just the familiar man with a hoe, or as is often the case, a woman with a hoe, chopping out the cotton. Why is it that the machines are not used for this purpose or if used why is the use not wide? If the machines are not practicable and cannot be used with success, it seems there would still be a field for useful inventive effort when we consider the tremendous acreage devoted to this staple crop.

High-grade Gasoline from Natural Gas.—In view of the great advance made recently in the production and marketing of gasoline produced from the gas from natural oil wells, there seems to be opportunity for invention in the systems of production as well as in the means for dispensing the commodity. This gasoline is highly volatile and is confined in steel drums or cylinders and the dispensing problem appears to involve means which will control the volatile liquid and which means will be so disposed as to be protected from mechanical injury by contact with objects exterior of the drum or container.

A Pad for Artificial Teeth.—*In re* Moore, the Court of Appeals of the District of Columbia, by Chief Justice Shepard in affirming in part and reversing in part the decision of the Commissioner of Patents, has held to be patentable, claims for a pad of particular form to be worn between the gums and a plate for artificial teeth, in view of affidavits of skilled and experienced dentists that this pad provides an effective remedy for the trouble arising from false teeth and tender gums and that they had constantly exercised their energy and skill to find a remedy therefor, but without success.

Legal Notes

"Evergreen" is a Descriptive Word.—In Brakeley v. The Sears & Nichols Company, the Commissioner of Patents has held the word "evergreen" to be descriptive as applied to canned fruits and vegetables as it would convey to the average purchaser the idea that the goods so marked are in as nearly a natural and fresh condition as it was possible to prepare them and that they would remain so.

Concealment of Invention.—There is always a danger in concealing an invention. Along this line, Assistant Commissioner Tennant has decided in the case of Baetz v. Kukkuck. An award of priority was made to K. on the ground that certain machines built by B., who was the first to conceive the invention in issue, did not constitute a reduction to practice and that B. was not diligent, or that if these machines did constitute a reduction of the invention B. had lost his right by concealment.

The Value of Actual Open Reduction to Practice.—Assistant Commissioner Billings in the case of Whitney v. Brewer reversed the decision of the Examiners-in-Chief and awarded priority to Whitney, although Brewer was the first to conceive the invention, since the device built by Brewer prior to Whitney's reduction to practice was either an abandoned experiment or, if a reduction to practice of the invention, was so concealed by Brewer that he forfeited his right to a patent in favor of Whitney.

Invention by Joint Inventors.—Of interest to joint inventors is the case recently decided in the Court of Appeals of the District of Columbia of Mills & Conn v. Darlington & Mills & Conn v. Elliott & Darlington in which the Court held that "The burden of proof is upon the junior party to an interference, and where such junior party consists of joint applicants, the burden is upon them to establish that they jointly conceived the invention at or about the time alleged in their preliminary statement."

Reduction to Practice.—The necessity of proceeding beyond the drawing and model stage of invention is forcibly stated in Reeves v. Keystone Bridge Company, 5 Fisher, 456, in which the Court held,

"It would indeed be a strange perversion of the purpose of the patent laws if one who has conceived of a new device, and proceeded so far as to embody it in rough sketches, or even in finished drawings, could there stop and yet hold that field of invention against all comers for a period of twelve years."

Also in Croskey v. Otterbury, 76, O. G., 163, in which the Court quoted from Porter & Londen, 73, O. G., 1551, as follows:

"A party who conceives a new device or invention and proceeds only so far as to embody it in rough sketches or drawings, or even experimental or working models, cannot stop there and still be able to hold the field of invention against all other inventors for an indefinite period."

It is important that he should put the invention in practical, usable form and successfully use it and also to file his application for patent in the United States Patent Office.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

HAT PIN.—T. M. DANIELS, 234 S. La Salle St., Chicago, Ill. A material check to the general adoption of guards for hat pins is the fact that the guard when removed is often misplaced and cannot be found when wanted. This is due to the fact that no means is provided to keep the pin and guard assembled when the pin is being drawn from and passed into the hat, the guard being generally removed and placed often where forgotten and lost. These objections are overcome by providing the head of the pin with a guard holder and a guard adapted to be received and held on the holder and fit over and shield the point of the pin. The engraving gives a side view of the pin showing the guard in full lines and in dotted outline in position of use on the point of the pin.

HAT PIN.

Pertaining to Aviation.

FEATHERING PADDLE WHEEL.—F. J. SCHNEIDER, 2200 Metropolitan Ave., Middle Village, L. I., N. Y. It is the aim of this inventor to adapt a paddle wheel for aeroplane work, and by means of which he can use one set of blades to deliver a thrust downward to aid in supporting the aerial vessel, and the other set to deliver a thrust rearward, to propel it.

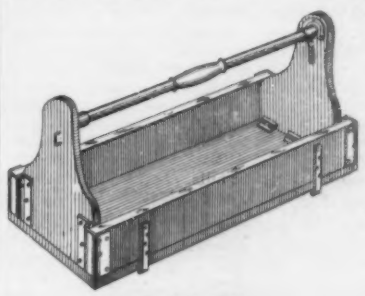
Of Interest to Farmers.

APPARATUS FOR DRYING MILK.—J. MCINTYRE, care of I. W. Parmentier, care of National Milk Powder Co., 38 Park Row, New York, N. Y. This apparatus is arranged to insure the production of separate solid particles of the milk without danger of spoiling the batch or injuring the product, by rendering the non-fatty solids insoluble, thus allowing reconstruction of the milk by dissolving the product in water under application of heat, to obtain a solution akin to natural normal milk.

PROCESS FOR TREATING MILK.—J. MCINTYRE, care of I. W. Parmentier, care of National Milk Powder Co., 38 Park Row, New York, N. Y. In this process the milk is concentrated and formed in one continuous operation into separate solid particles in the form of powder and granules, from which, by the addition of water and the application of heat, milk can be reconstructed that is akin or practically true to the original milk in color, solubility, natural souring and coagulating by the rennet test.

Of General Interest.

FOLDING BOX.—J. C. GORDON, New London, N. H. Mr. Gordon's invention relates to improved folding boxes and it has for its object the provision of a strong and a well-braced box, which may be used by carpenters and other mechanics for carrying tools, the box being so constructed that it may be conveniently packed in a small space. The handle held securely to the end members, assists in bracing the box. The accompanying engraving illustrates a perspective view of the invention.

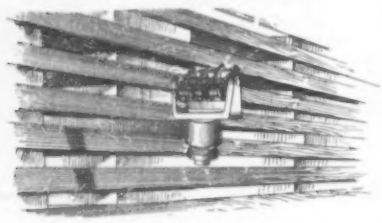


FOLDING BOX.

DISPENSING DEVICE.—C. V. CASE and C. J. CASE, 118 Orange Ave., Bartow, Fla. More particularly this invention involves a form of hopper and spout, especially adapted for grocers' use. One purpose is to provide a device adapted for attachment to any suitable bin and provided with means whereby a determined amount of material contained in the bin may be dispensed.

PORTABLE DITCH DAM.—A. CADWALLADER, R. F. D. No. 2, Box 55, Bushnell, Ill. The object here is to provide an easily transported, and easily set and knocked down device especially adapted for use in irrigating, or in other conditions when a temporary dam is required, which will effectually permit the passage of the water.

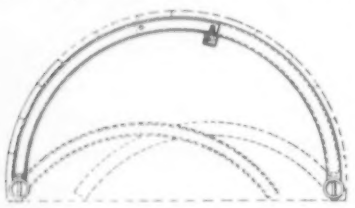
LUMBER JACK.—C. E. EVANS, care of Weed Lumber Co., Weed, Cal. The object of this invention is to provide a jack which may be used to assist in raising and lowering lumber. The jack is constructed to slide with a counter-balanced member for engaging the lumber, this member being pivoted to a yoke,



LUMBER JACK.

and the yoke being pivoted on a vertical axis to a beam, thereby permitting the jack to be moved as desired while it engages and holds the lumber which is being moved. Means limit the movement of the yoke and hold it yieldingly in a predetermined position. The view herewith is in a perspective showing the jack in position for use.

COLLAPSIBLE FORM FOR CONCRETE CULVERTS.—W. BURGNER, Carthage, Ill. The aim of this inventor is to provide a collapsible form for concrete culverts. For this purpose use is made of a skeleton frame formed of side bars, transverse arch ribs, each made in sections, secured to the said side bars, and having their free ends overlapping, and a top bar extending underneath the arch



COLLAPSIBLE FORM FOR CONCRETE CULVERTS.

ribs and provided with longitudinal pins adapted to engage registering apertures in the said rib sections. The illustration shows an enlarged elevation of the frame of the form.

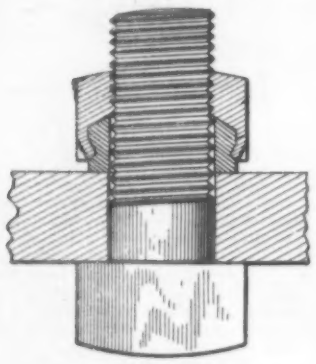
CHAIN.—W. D. TUSTEN, 757 Macon St., Brooklyn, N. Y. The invention pertains to chains, and particularly to the construction of the links thereof; and the object is to provide a device which can be used in the making of watch chains, bracelets, and other articles intended to be used for ornamental purposes.

COLLAPSIBLE WIRE BASKET.—LILLIAN POPPERT, care of Poppert & Kirk, 2045 E. Washington St., Portland, Ore. This invention relates to a new and improved form of folding wire basket, and an object is to provide a basket, the several parts of which may be collapsed to form a neat, economically arranged structure and one which cannot be accidentally collapsed when in use.

BOTTLE STOPPER.—W. FUHR, 784 Grand St., Brooklyn, N. Y. This invention relates to improvements in bottle stoppers, and the intention is to provide a structure which will readily permit the fluid in the bottle to flow therethrough when the bottle is inverted, but will resist refilling of the bottle at all times.

Hardware and Tools.

NUT LOCK.—J. J. HERZOG, 108 Clay St., Baltimore, Md. In the present patent the object of the inventor is to provide a simple and effective nut lock constructed in such a manner that the nut can be screwed to a bolt



NUT LOCK.

with a soft metal bushing or washer, the two being so constructed as to form a single article of manufacture adapted to be sold and used as such. The accompanying engraving is a sectional view showing the nut applied to a screw bolt and provided with a bushing of soft metal as it appears before compression.

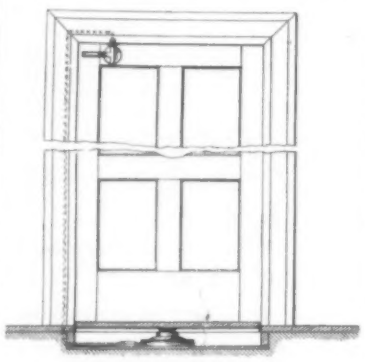
KEY OPERATED LOCK.—F. BISESI, 307 E. 11th St., Manhattan, N. Y. This invention provides a lock with a plurality of bolts; provides in a lock a plurality of keys operable successively upon a lock bolt which keys when used in reversed order retract the bolt previously protruded; provides a lock with a secret latch to lock the bolt in full extended position to require the release of the latch prior to retracting said bolt; and provides means to prevent use of a preceding key.

MOWER.—L. O. EKREM, 1628 N. Humboldt St., Chicago, Ill. This invention relates to mowers for mowing lawns, and for other like purposes, and refers more particularly to the combination of a mower having means whereby it can be manually operated, with means for supporting the mower upon the person of the operator, so that both hands of the operator are left free for manipulating the operating mechanism.

Household Utilities.

WASHING MACHINE.—P. WERNER, care of E. Spindler, 325 W. 29th St., New York, N. Y. This invention provides a mechanism arranged for packing within the smallest compass; provides a machine which may be removably attached to ordinary wash tubs; provides a mechanism readily disposed within the tub provided for its operation, the disposition whereof permits employment of the tub for purposes other than for which the mechanism is provided; and to produce a machine to supplement hand labor in the domestic wash.

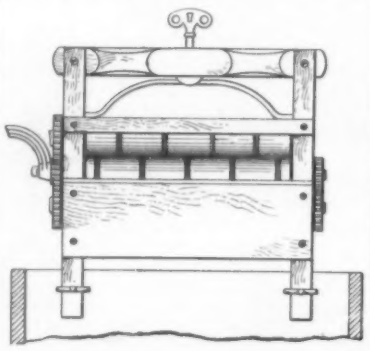
DOOR OPERATING DEVICE.—C. ALTER, 500 E. 83rd St., Manhattan, N. Y. This device is for use on doors of stores and other buildings, and is arranged to permit a person carrying packages or the like, or otherwise encumbered, to open the door on stepping on a platform in front of the door, the door being held in open position to allow a person to conveniently pass through the open door-



DOOR OPERATING DEVICE.

way, to insure self closing of the door after the person has passed through the door-way. For this purpose use is made of a pneumatic pressure actuating device connected with the door, and a pneumatic pressure connected with the said actuating device to supply the latter with air pressure to open the door. The illustration shows a side elevation of a door in closed position and provided with the improvement shown partly in section.

WRINGER.—W. H. VALENTINE, Glen Cove, L. I., N. Y. Mr. Valentine's invention relates in general to a wringer, and more particularly to a device attachable to a clothes wringer of either hand- or power-operated construction, and an object of his improvement is to prevent the wrapping of the clothes about the



WRINGER.

wringer rolls. He attains these objects by modifying the rollers in devices now in common use by grooving the same and disposing in the grooves guiding fingers mounted upon the framework of the wringer and extending through the contacting surfaces of the rollers and projecting beyond the rollers so as to carry the clothes in a tangent position to the line of direction of the rotating rollers. The engraving shows a front elevation of the wringer.

MOP HOLDER.—D. MARGOLIUS, Box 125, Spartanburg, S. C. This improvement relates to holders for mops used for the purpose of cleaning floors; and it conprises means for securing cloth or mop material on the end of a handle by means of which the mop is moved over the floor or other surface to be cleaned.

Machines and Mechanical Devices.

CALCULATING MACHINE.—NELSON STAFFORD, 67 Fulton St., Brooklyn, N. Y. This invention provides a machine wherein are imprinted in column form a succession of numbers, and wherein may be imprinted at will the totals of column sections, or the result of a succession of such totals; and provides means for exposing to view at will the composited number designed for addition to the column and the number indicating the total of the column inclusive of the number composed for addition thereto.

SUBMARINE RESCUING APPARATUS.—S ROTH, 161 E. 103rd St., Manhattan, N. Y. This invention comprises a casing which is secured to the hull of the submarine, this casing having trap doors therein and suitably controlled mechanism, by means of which the trap door can be so operated as to permit each member of the crew to enter the casing and make his exit from the hull of the submarine in turn.

ORE LOADER.—N. P. FLODIN, care of A. Matthews, Marquette, Mich. In this case the invention refers to a loading apparatus, whereby one or other material can be loaded from a pile on the ground to a car on which the apparatus can be mounted, or which may be brought up to the apparatus in car loading relation thereto.

DITCHING MACHINE AND TILE DISTRIBUTER.—A. E. HANSON, Mason City, Iowa. The object of this inventor is to provide a new and improved ditching machine and tile distributer, arranged to readily form the ditch, and to distribute the tiles in the bottom of the ditch, one in front of the other.

CURRENT MOTOR.—C. A. NEYLAND, 324 Hutton Bldg., Spokane, Wash. This invention provides a motor more especially designed for use on a flowing stream, tide water or other moving body of water, and arranged to actuate a pump or other mechanical contrivance in a very effective manner, and to utilize the force of the moving body of water to fullest advantage.

POST HOLE DIGGER.—W. O. GOODWIN, care of George A. Perrill, Salina, Kan. Elevating means are connected with this mechanism for removing earth from the hole bored and delivering the same for removal; means are provided for guiding the boring tool and mechanism for operating the same; to form holes, the extension whereof is inclined from the vertical; and a truck is provided with a self-contained motor and with transmission mechanism connecting the motor with the traction wheels and the boring mechanism alternately.

Prime Movers and Their Accessories.

STEAM ENGINE LUBRICATOR.—D. MOREHOUSE, Delphos, Ohio. This improvement is more particularly designed to be used in connection with engines using superheated steam. It provides a device in which successful lubrication may be accomplished in spite of the high temperature of the superheated steam, which cannot be accomplished by means of an ordinary lubricating device.

CARBURETER.—W. H. BROWNING, 16 Cooper Sq., Rye, N. Y. The carbureter is for use in gasoline and like explosive engines, and arranged to permit convenient and accurate adjustment of the needle valve by bodily moving the same instead of turning and screwing the needle valve in or out, and to hold the members of the air admission valve in firm contact with each other by the suction of the engine in drawing in the air.

Railways and Their Accessories.

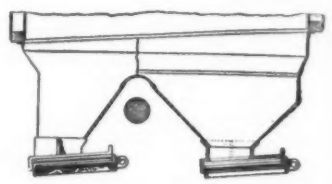
GUARD RAIL CLAMP.—S. MUNSON, Fowler, Colo. This clamp is arranged to permit of conveniently placing it in a position on a traffic rail and its guard rail, and to allow of fastening it in place without weakening the web of the traffic rail for the passage of bolts or other fastening devices.

CAR COUPLING.—M. W. KIRKLAND, Box 114, Abbeville, Ala. The object of this inventor is to produce a coupler of simple construction which will couple automatically when the cars are brought together, but which can be readily operated from the side of the coupler so as to disconnect the coupler when desired.

CAR FENDER.—T. J. KILLEEN, 165 Market St., Portland, Ore. This fender may be adjusted for traveling close to the ground without danger of tripping, the fender being constructed with a pivoted contact fender and a pivoted drop fender supported by the former, with means for forcing the drop fender downward and forward when the contact fender is moved rearwardly.

REINFORCED CONCRETE RAILWAY TIE.—L. T. LEWIS, R. F. D., No. 3, Fletcher, Okla. This railway tie is formed of cement or concrete and a reinforcement consisting of a skeleton metal frame. The latter is of peculiar construction, it being formed of three principal parts which are so constructed and connected that the frame combines maximum strength, rigidity, and lightness.

LOCOMOTIVE ASH PAN.—J. F. DUNN, care Oregon Short Line, Salt Lake City, Utah. In this patent the improvement relates to ash pans, and more especially to those used on locomotives, and has for its object to provide one having a guide member secured to the bottom of a hopper, the guide member having



LOCOMOTIVE ASH PAN.

inclined outer slide bearings and depending end members, a door for closing the hopper, having bearing members for engaging the slide bearings on the guide member, and an end member for engaging the upper depending end member, the lower depending end member on the guide member serving to prevent the ashes from falling off the door when closed, and the upper depending end member on the guide member serving to push the ashes off the door as it is opened. There is practically no danger of water accumulating in the pan from reaching the slide bearings, which in winter weather, would freeze up and become inoperative, as would be the case with inside bearings. The illustration shows an elevation of the invention.

Pertaining to Recreation.

GRIP DUMB BELL.—J. C. KORTH, 1139 Tiffany St., Bronx, N. Y. The object here is to combine a dumb bell with a hand grip exerciser, with a view to provide the desired weight and to cause an alternate tension and relaxation of the muscles of the hand, wrist and arm when used for a physical exerciser, and to permit of increasing the weight when exercising with the dumb bell without the grip exerciser.

Pertaining to Vehicles.

WHIFFLETREE.—T. MARTIN, care of Hon. D. R. Pearson, Richmond, Tex. This invention is an improvement in draft devices in the nature of whiffletrees which may be embodied in doubletrees, swingletrees, draft eveners or similar devices. It facilitates the connection and disconnection of coupling devices which may be in the form of trace hooks or otherwise, and which will permit the connection of trace chains should a trace hook or link become broken.

TRANSMISSION GEARING.—G. W. MEREDITH, 486 16th St., Detroit, Mich. While otherwise useful, this invention is particularly applicable to motor-driven vehicles. The improvement provides for accurate adjustment of parts relative to one another, thereby making the most efficient means for securing and distributing and equalizing the pressures of contact, so as to obtain a transmission of the maximum horse-power.

Designs.

DESIGN FOR A CIGAR LIGHTER.—A. C. HEATH, 380 Canal St., New York, N. Y. This ornamental design for a cigar lighter represents the Metropolitan Life Insurance Company's building, and the lighter issues from the top of the tower point. The ash and cigar holder portion of the design consists of a pavement with each of the four corners provided with a deep saucer shaped depression and oblong ones on the four sides.

DESIGN FOR A TOY ANGORA POODLE DOG.—J. W. BERKOF, New York, N. Y., care of Independent Toy Works, 540 Grand St., Brooklyn, N. Y. This ornamental design for a dog presents an Angora poodle in a sitting position, with a narrow band around the neck and bowed in front. The hair is thick and long and from head and tail only.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We are prepared to render opinions as to validity or infringement of patents, or with regard to conflicts arising in trade-mark and unfair competition matters.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & CO.,
Patent Attorneys,
363 Broadway,
New York, N. Y.

Branch Office:
625 F Street, N. W.,
Washington, D. C.

PATENT ATTORNEYS

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of more than sixty years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to PATENTS, TRADE MARKS, FOREIGN PATENTS, etc.

All patents secured through us are described without cost to the patentee in the SCIENTIFIC AMERICAN.

MUNN & COMPANY
361 BROADWAY, NEW YORK
Branch Office, 625 F Street, Washington, D. C.

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AGENTS

AGENTS AT ONCE.—Something new. Model Spring Winder. Makes springs any size from any kind of spring wire. Rapid, efficient and powerful. Indispensable to every factory, farm, shop, garage, printing office. Attaches to any workbench in a minute. Sell one, make $2.50 profit. You can sell 10 a day easy. Let's get going. National Manufacturing and Sales Company. 350 Huron Street, Toledo, Ohio.

AUTOMOBILES AND MOTORCYCLES

AUTOMOBILES, $50.00 up; Motorcycles, $20.00 up; guaranteed for one year, shipped freight, prepaid. Largest list and lowest prices in the world. King, Automobile Broker, Dept. S. A., 215 West 125th Street, New York City.

BUSINESS OPPORTUNITIES

INVENTORS desiring to market meritorious patented articles of general demand address National Manufacturing and Sales Company, 350 National Union Building, Toledo, Ohio.

PATENTS FOR SALE

FOR SALE. Patent No. 1011563 on the greatest amusement apparatus, game and toy ever invented. Can show the wonderful earning qualities of this patent. Richard M. Brenner, Box 103, Palisade, N. J.

FOR SALE outright or on royalty basis, with a good firm, Patent No. 627535, for a folding shipping crate and stack rack. Would be willing to go on road to help introduce it. Royalty, Box 773, New York.

MISCELLANEOUS

FREE SAMPLE goes with the first letter. Something new. Every firm wants it. Orders from $1.00 to $100.00. Nice pleasant business. Big demand everywhere. Write for free sample. Metallic Mfg. Co., 438 N. Clark, Chicago.

A SMALL ADVERTISING NOVELTY has been invented and is being patented which is sure to meet with an enthusiastic reception. There will be enormous sales. The article is made of a piece of tin and some pieces of card board. A working model will be sent to a reliable concern desiring to investigate with a view of manufacturing on a royalty basis. R. E. Jones, Ft. McPherson, Ga.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry may be repeated. **MUNN & CO., Inc.**

Inquiry No. 9264.—Wanted, the name and address of manufacturers of Date Fitting Machines.

Inquiry No. 9265.—Wanted, names and addresses of manufacturers of machinery for making picket fences.

Inquiry No. 9266.—Wanted, to buy machinery for fastening wire cloth to wooden frames with coppered tacks.

Inquiry No. 9267.—Wanted addresses of manufacturers of metal specialties in connection with plate or window glass.

Inquiry No. 9273.—Wanted, to buy a globe for a parlor fountain, working on the Heron system.

Inquiry No. 9274.—Wanted, the name of a manufacturer of a machine to make cushion covers for fruit crates.

Inquiry No. 9275. Wanted, name and address of manufacturer of stock patterns of platen job printing presses.

Inquiry No. 9276. Wanted a household convenience and necessity which can be retailed at a profit at a price of from $1.00 to $2.00.

SECOND EDITION

32 Page Booklet on
Wall Street
Treating fourteen subjects relating to
Odd Lot Investments
AND
Our Semi-Investment Plan
Free Upon Request
LEAVITT & GRANT
Established 1908
Members Consolidated Stock Exchange of N. Y.
55 Broadway, New York

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12647) W. L. L. asks for information as to the water level on the two sides of the Isthmus of Darien at the ends of the Panama canal. A. There is a popular impression that the water at the Pacific end of the canal is permanently higher than it is in the Caribbean Sea at the northern end of the canal. In order to obtain the facts in the case we referred the inquiry to the Canal Commission on the spot. We give the reply received: "There is no difference between mean sea-level in the Caribbean Sea at Colon and mean sea-level in Panama Bay on the Pacific side of the Isthmus, but at Colon the tide rises only about nine inches above mean sea-level and falls nine inches below mean sea-level, while at Panama the water at high tide rises to a height of ten feet above mean sea-level and falls at low tide to ten feet below mean sea-level. The water at Panama at high tide is slightly more than nine feet above the elevation of the water at Colon, while at low tide the situation is reversed and the water at Panama is slightly more than nine feet below the level of the water at Colon." This statement is authoritative and may be taken as settling a much-discussed question. We are often asked why is the water in the Pacific Ocean higher than the water in the Caribbean Sea on the other side of the Isthmus of Darien. We can now answer the conundrum, that it isn't so.

(12648) F. H. asks: Put a teaspoonful of common table salt in a tumbler and pour the same full of hot water (say 115 degrees Fahr.). Hold the glass between the middle finger and thumb of left hand and stir for a moment with the handle of a toothbrush or knife and then gently tap the center of the bottom of the glass with the handle of the toothbrush in a regular rhythm, say once every one-half second. This tapping will produce an acoustic phenomenon, namely, a succession of tones starting with a certain note, then go lower in tone for a short while, and then go gradually up to a very high note. What is the cause of this? A. The rise in pitch of the tone from a glass of hot water which has been stirred briskly is due to the escape of the air from the water. If you will use some foaming mixture, such as a Seidlitz powder or baking powder, which evolves a gas upon the addition of water, you will have a still more striking experiment. You will notice that the pitch of the tone ceases to rise when the air has all escaped from the water.

(12649) A. L. G. asks: Mr. Thorlington Chase writes a letter to you, published under date of March 2nd, which has interested me very much for the reason that I have often wondered whether or no our increasing attacks upon the atmosphere might not in the end have a disastrous effect upon the delicate balance at present existing between its constituents. But one matter he has omitted to mention. Because of the unavoidable and immediate disappearance of the natural deposits of the nitrogen compounds necessary for fertilization purposes, our inventors are striving by every means in their power to find a method of converting the nitrogen of the air to practical use. Their efforts to do this in a way that shall be cheap enough and in bulk that shall be large enough are now within sight of success. When the nitrogen begins to be withdrawn from the air in such huge quantities as will then be demanded, what will happen to the "delicate balance" of the constituents of the atmosphere, and what will happen to us? A. We publish the letters in our Correspondence Column without any indorsement of the opinions expressed by the writers. Indeed, often we hold the very opposite opinions, but deem it fair to let our readers have views upon questions from different angles. The exhaustion of the atmosphere of its oxygen or its nitrogen is a much more stupendous undertaking than is the exhaustion of the coal supply. The weight of the atmosphere is 5×10^{15} tons, 5 followed by 15 ciphers. Of this 1/5, or 1 quadrillion tons, is oxygen. There are four times as many tons of nitrogen. These are unthinkable quantities. The nitrogen is not drawn upon in nature to any extent. The oxygen taken by animals is returned by plants in due proportion. The depletion of the forested area is frequently not followed by a desert area. Other crops, grains, vegetables, fruits, and varied forms of vegetable life, take the place of the trees, and the chemical work of restoring the oxygen goes on, although the quantity of timber is lessened to an alarming extent. The proportion of the gases in the air has not changed appreciably since man began to investigate this matter. What may be the case ages hence we may speculate about, but cannot prove.

Who recommended your lubricating oil? *That is vital.*

Automobile lubricants are like automobile parts.

They must fit the car they are used on.

The correct oil cannot be determined by simple tests. Most motorists must depend on advice.

Dealers who handle Gargoyle Mobiloil can give you the specific recommendations of the Vacuum Oil Company—the recognized leaders in lubrication.

We supply them with a guide chart (printed in part below). The chart was prepared after a careful analysis of every American car and practically every foreign make. It will show you the correct grade of lubricating oil for your car (summer and winter).

In power-engineering circles these recommendations from us would be accepted as authoritative. You may feel assured that, in quality, the oils specified on the chart set a world standard.

They are put up in barrels, half-barrels, and in 5 and 1 gallon sealed, white cans.

The oils (refined and filtered to remove free carbon) are named:

Gargoyle Mobiloil "A."
Gargoyle Mobiloil "B."
Gargoyle Mobiloil "D."
Gargoyle Mobiloil "E."
Gargoyle Mobiloil "Arctic."

All are branded with the Gargoyle, which is our mark of manufacture.

A guide to correct Automobile lubrication

Explanation: In the schedule the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used. For example, "A." means "Gargoyle Mobiloil A." "Arc" means "Gargoyle Mobiloil Arctic." For all electric vehicles use Gargoyle Mobiloil A. The recommendations cover both pleasure and commercial vehicles unless otherwise noted.

MODEL OF CARS	1908		1909		1910		1911		1912	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit					A	Arc.	A	Arc.	A	Arc.
Alco			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
American	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Apperson	E	E	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Atlas	A	A	E	E	E	E	E	E	A	A
" Com'l			E	E	E	E	Arc.	Arc.	A	A
Austin	A	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.
Autocar (2 cyl)	B	A	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (2 cyl) Com'l			A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (4 cyl)	A	E	A	E	A	E	A	A	A	A
Benz			A	A	A	A	A	A	A	A
Bergdoll					A	Arc.	Arc.	Arc.	Arc.	Arc.
Brush	A	A	A	E	A	E	A	E	A	E
Buick (3 cyl)	A	A	A	A	A	A	A	A	A	A
" (4 cyl)	A	Arc.	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.
Cadillac (1 cyl)	A	E	B	A						
" (4 cyl)	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Cartercar	A	E	A	A	A	E	A	E	A	E
" Com'l	B	A	A	A	A	E	A	Arc.	A	Arc.
Case				A	A	A	A	A	A	A
Chadwick	A	A	A	B	A	A	A	Arc.	A	Arc.
Chalmers			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Chase	B	B	B	B	B	B	B	B	B	B
Cole				Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Columbia	A	E	A	E	E	E	A	A	A	A
Columbia Knight									A	A
Couple Gear	A	A	A	A	A	A	A	A	A	A
Croxton-Keeton				A	Arc.	A	Arc.	Arc.	Arc.	Arc.
Daimler	A	E	A	A	E	A	E	A	A	A
Daimler Knight						A	E	A	A	A
Darracq	A	E	A	E	A	E	A	E	Arc.	Arc.
De Dion	B	A	B	A	B	E	B	A	B	A
Delahaye	A	A	B	A	A	A	B	A	A	A
Delaunay-Belleville	B	A	B	A	E	A	B	A	B	A
Elmore	A	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
E. M. F.			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Fiat	A	E	B	A	A	A	E	A	A	A
Flanders				E	E	E	E	E	A	A
Ford	A	E	E	E	A	Arc.	E	E	E	E
Franklin	B	E	B	E	A	A	Arc.	A	Arc.	Arc.
" Com'l	B	E	B	A	B	A	A	A	Arc.	Arc.
Gramm							A	Arc.	A	Arc.
Gramm-Logan			A	Arc.	A	Arc.				
Hewitt (2 cyl)			A	A	A	A	Arc.			
Hewitt (4 cyl)	A	A	A	E	A	E	A	Arc.	E	E
Hudson				Arc.	Arc.	A	Arc.	A	Arc.	Arc.
Hupmobile			Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
International	B	A	B	A	B	A	B	B	B	A,
Interstate			A	E	A	E	A	Arc.	A	Arc.
Jeffery	A	E	A	A	A	A	A	A		
Italo			A	A	A	A	A	A	A	A
Jackson (2 cyl)	A	A	A	A	A	A				
" (4 cyl)	A	E	A	E	A	Arc.	A	Arc.	A	Arc.
Kelly							Arc.	Arc.	Arc.	Arc.
Kissel-Kar	A	E	A	E	A	E	A	Arc.	A	Arc.
" Com'l							Arc.	Arc.	Arc.	Arc.

MODEL OF CARS	1908		1909		1910		1911		1912	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Kline Kar					Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Knox	B	E	B	A	B	A	B	A	B	A
Knit					A	A	A	A	A	A
Lambert	A	E	A	A	A	Arc.	A	Arc.	A	Arc.
" Com'l	A	A			A	E	A	E	A	E
Lancia	B	A	B	A	B	A	B	Arc.	B	Arc.
Locomobile	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Lozier	A	A	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Mack	A	A	A	E	A	E	A	E	E	E
Marion	A	A	A	E	A	E	A	E	A	E
Marmon	B	E	Arc.	Arc.	A	E	A	Arc.	Arc.	Arc.
Matheson	A	E	Arc.	A	Arc.	Arc.	Arc.	A	A	A
Maxwell (2 cyl)	E	E	E	E	E	E	E	E	E	E
" (4 cyl)			E	E	E	E	Arc.	Arc.	Arc.	Arc.
Mercedes	A	E	A	E	A	E	A	A	E	A
Mercedes Knight								A	A	A
Mercer					A	Arc.		A	Arc.	A
Minerva Knight									A	A
Mitchell	A	E	A	A	Arc.	Arc.	A	Arc.	A	Arc.
Moon	A	E	A	A	A	E	Arc.	Arc.	Arc.	Arc.
National	A	E	A	Arc.	A	A	A	A	A	A
Oakland			A	E	A	E	A	Arc.	A	Arc.
Oldsmobile	A	E	A	E	A	E	A	Arc.	A	Arc.
Overland	A	E	A	E	A	E	Arc.	Arc.	Arc.	Arc.
Packard	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Panhard	A	E	A	E	A	E	A	A	A	E
Panhard Knight							A	A	A	A
Peerless	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pennsylvania	A	E	A	E	A	E	A	A	A	A
Pierce Arrow	A	E	A	E	Arc.	Arc.	Arc.	Arc.	A	Arc.
" Com'l							Arc.	Arc.	Arc.	Arc.
Pope Hartford	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Premier	A	E	A	A	A	A	A	A	A	Arc.
Rambler	A	A	A	A	A	A	A	Arc.	Arc.	Arc.
Rapid	A	A	A	A	A	A	A	Arc.	Arc.	Arc.
Regal			A	Arc.	A	Arc.	A	Arc.	A	E
Renault	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	A	A	A	A	E	A	Arc.	A	Arc.
Royal Tourist	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Selden	A	E	A	E	A	E	A	Arc.	A	Arc.
Simplex	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Speedwell		A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	A
Stanley	D	D	D	D	D	D	D	D	D	D
Stearns	A	E	A	A	Arc.	Arc.	A	A	A	A
Stearns Knight									A	A
Stevens Duryea	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Stoddard Dayton		E	E	E	Arc.	A	A	A	A	A
Stoddard Dayton-Knight									A	A
Thomas	A	E	E	E	E	E	E	A	E	E
Walter	A	E	A	E	A	E	Arc.	Arc.	Arc.	Arc.
Welch	A	E	A	E	A	E				
Welch Detroit							A	E		
White (Gas)					Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (Steam)	D	D	D	D	D	D	D	D	D	D
Winton	A	E	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc

VACUUM OIL CO., Rochester, U. S. A.

Distributing warehouses in the principal cities of the world.

ELLIS
USE GASOLINE, KEROSENE OR DISTILLATE
Develops more than rated power. Uniform speed. Governor adjustable while running. Force feed oiler. Sight feed fuel supply. Auto muffler. Steers engine throttle giving
THREE ENGINES IN ONE
Many other features. Sent on 30 days Free Trial with freight prepaid; no sale until satisfied. Ten year guarantee. Big new catalog FREE.
ELLIS ENGINE CO., 57 Mather St., Detroit, Mich.
ENGINES

Time to Build Your Boat

Complete Patterns and Instructions from $2 to $12
LET us send you complete parts for a boat, shaped and fitted. Easy to assemble. Save two-thirds boat builder's price. Satisfaction guaranteed or your money back. Only $25 for 23-foot power boat—12 passengers—speed 9½ to 14 miles an hour. Knock-down frame with full-sized patterns to finish by. The boat season comes soon, so
Write For Brooks Boat Book
with 72 pages of illustrations and descriptions of row boats, canoes, sail and motor boats that you can build. Address
BROOKS MFG. CO., 8506 Rust Ave., Saginaw, Michigan

DURYEA MOTOR BUGGIES

YOU can now get a motor-buggy which is reliable—light, simple, strong. You can depend on it and sell the horse. Our rigs have solid tires. If you do not need high speed, they are better for every purpose than automobiles. They have perfected 2-cycle, air-cooled engines, and a well-established system of roller drive which eliminates nearly all the moving parts. They are far more economical than anything else can be. They are handsome in appearance, run smoothly, and are very comfortable. They are better made than most automobiles. Prices from $600 to $750. Write for catalogue.
C. S. Duryea Motor Co., Saginaw, Mich.

OILDAG
Reg. U. S. Pat. Off.
is the new Lubricant which contains Deflocculated Graphite given to the world as one of the results of extended scientific research on the part of Dr. E. G. Acheson.
No Automobile, Truck, Motor Boat, Motorcycle, Aeroplane or other gas engine unit on which Oildag is not used is run at highest efficiency. Booklet L-458 Tells All About It.
SEND YOUR ADDRESS FOR IT.
International Acheson Graphite Co.
Niagara Falls, N. Y.
General Agents for Oildag, made by Acheson Oildag Company

ROTARY PUMPS AND ENGINES

Their Origin and Development

An important series of papers giving a historica resume of the rotary pump and engine from 1588 and illustrated with clear drawings showing the construction of various forms of pumps and engines, 38 illustrations. Contained in Supplements 1109, 1110, 1111. Price 10 cents each. For sale by Munn & Co., Inc., and all newsdealers.

SANDOW MARINE ENGINE
8 h. p., 2 cylinder, $125.00
4 h. p., 1 cylinder, 57.00
2 h. p., 1 cylinder, 39.75
Starts without cranking
BUILT LIKE AN AUTOMOBILE ENGINE.
2 to 20 h. p., ready to ship; gasoline or kerosene. Driven boats of all kinds; starts easy; cannot backfire; almost noiseless. 5-Year Absolute Guarantee—30-Day Trial. Three moving parts—women and children run it. Demonstrate an engine for us and get yours at cost. Be first in territory to get offer.
Sales plan and literature Free
Detroit Motor Car Supply Co.
18 Helen Ave., DETROIT, MICH. Write today.

PORTLAND CEMENT MAKING is described in excellent articles contained in Scientific American Supplements 1433, 1465, 1466, 1510, 1511. Price 10 cents each. For sale by Munn & Co., Inc., and all newsdealers.

CRUDE ASBESTOS
DIRECT FROM MINES
PREPARED Asbestos Fibre for Manufacturers use
R. H. MARTIN
OFFICE, ST. PAUL BUILDING
220 Broadway, New York

ELECTRIC MOTORS
Dynamos
Grinders
Polishers
SPECIAL MACHINES
ROTH BROS. & CO.
198 Loomis Street, Chicago, Ills.

Detroit Marine Engine
Uses Gasoline or Kerosene

Demonstrator Agents wanted in each boating community. Special wholesale prices on first sold. Amazingly easy to operate, HALF operating cost, gives more power, will not back-fire. Engine starts without cranking; reversible, only three moving parts.
New Catalog FREE
outfitting tool included if not satisfied. 1, 2 and 4 cyl. 2 to 90 h. p. Suitable for any boat; canoe, motor, cruiser—or R. R. truck car. Join boosters club. Send for catalog.
Greatest Engine Bargain ever offered. Money refunded if not satisfied.
Detroit Engine Works, 1322 Jefferson Avenue, Detroit, Mich.

NEW BOOKS, ETC.

TRANSACTIONS OF THE AMERICAN CERAMIC SOCIETY. Vol. XIII. Containing Papers Read at the Meeting Held at Trenton, N. J., February 14th, 15th, and 16th, 1911. Published by the Society. Secretary's Office, Columbus, Ohio, 1911.

The papers recite the experiences and conclusions of men prominent in ceramic manufacture. They are for the most part of a very technical nature, replete with diagrams, laws, and formulæ. Among those of practical bearing may be mentioned "The Calculation of Ceramic Mixtures," "Roofing Tiles and their Manufacture," and "The Construction of a Twelve-Foot Potter's Updraft Kiln," while discussions of historic or geologic interest are "Clay and Kaolin Mining in Europe," "The Formation of Residual Clay," and "The Clay Deposits of Washington."

THE ANIMAL WORLD. By F. W. Gamble, F.R.S. New York: Henry Holt & Co., 1911. 12mo.; 256 pp.; illustrated. Price, 75 cents net.

Sir Oliver Lodge has written an introduction to "The Animal World," in which he truly characterizes the utilization of matter by life as one of the outstanding puzzles of the universe; a puzzle, however, which he evidently believes susceptible of ultimate solution. The little work in hand assumes on the part of the reader an elementary knowledge of the ascending series of organisms, and, instead of regarding the animal kingdom as made up of groups and subdivisions, prefers to trace the similarity of function running through the series, emphasizing the various modes in which the functions are performed, the different organs developed for the purpose, and the reactions of achievement on form and of form on achievement. Thus the common needs of highest and lowest are strikingly shown, and the unity of life impressively indicated. The student of a philosophical trend of thought will find much to awaken his interest and to serve as a starting point for further reasoning and speculation.

HANDBUCH FUER HEER UND FLOTTE. Berlin: Deutsches Verlagshaus Bong & Co. 32 pp.; illustrated.

In this thirty-sixth instalment of the "Handbuch fuer Heer und Flotte," we find the first pages of a monograph on "wars," from ancient times to the present. The particular monograph is edited by Dr. Francis Smith, who had the assistance of sixty-three military officers, historians, etc. The underlying idea of this monograph was first proposed by Capt. von Albert. He contended that the usual encyclopedic method of alphabetically discussing military topics was faulty, because it necessitated arbitrary divisions of the subject matter without commensurate advantages. It is difficult to obtain a coherent account of any particular war simply by referring to the battles of that war. For that reason he proposed a chronological discussion of historic conflicts under the single reference word "wars." To facilitate the use of this general discussion for the casual reader who wishes to verify data or a locality, an alphabetical index was to be supplied, as well as a series of charts. This idea it is the intention of the editor of the Handbuch, Gen. Leut. von Alten, to carry out. The wars in this general discussion have been discussed largely from the standpoint of the general operations, for the simple reason that the various battles, sieges, etc., can be referred to in detail under their respective headings in the various volumes. The present instalment of this elaborate plan is not sufficiently extensive to permit our passing an adequate judgment upon it. The few pages that are here presented would indicate that the whole subject of wars will be treated from a very broad point of view, with the result that we can see not only how the art of war itself has progressed, but how politics and government themselves have been affected by the great conflicts of history. The significance of many a war lies not so much in its military processes, in its battles and victories and defeats, as in its social and political effects. Hence it is that Dr. Smith has decided to include uprisings and revolutions, which hardly deserve the name of wars.

HIGHWAYS AND BYWAYS OF THE GREAT LAKES. By Clifton Johnson. New York: The Macmillan Company, 1911. 8vo.; 328 pp.; illustrated. Price, $2 net.

Clifton Johnson has prowled about the shores of the Great Lakes with an open eye for the beauties and peculiarities of the region. He has fixed these upon paper for us in a conversational, even gossipy way, and human character has been given as much attention as natural scenery. The byways, too, have been favored above the highways, and present conditions are placed before us with but few lapses into history. Each chapter is followed by some suggestions for intending travelers, although the dissertation is intended to amuse and inform the stay-at-home reader rather than to serve as a guidebook to the tourist. The profuse illustration, credit for which is due to the writer, adds not a little to the appearance and value of the work.

MECHANICAL INVENTIONS OF TO-DAY. By Thomas W. Corbin. Philadelphia: J. B. Lippincott Company, 1912. 8vo.; 323 pp.; 112 illustrations and diagrams.

In an attractively clothed volume, replete with illustration and most entertaining reading, the great modern inventions are clearly described and explained. From James Watt's clever solution of the way to turn the circular path of the walking beam into the straight up-and-down motion of the vertical rod, on through a selected list of fundamental inventions to the complexities of the present-day steam engine, the ship-coaling machine, and the ship-building crane, the reason for everything is shown, the manner of its inception narrated, and the beauties and utilities of it demonstrated. In order not to interfere with the clarity of the explanations, unimportant parts and complications are not shown in the diagrams, but only the main features it is desired to elucidate. A chapter is devoted to the devices in use by the railroads, another to the wonderful ingenuity and work of the modern lathe, and yet another to the achievements which have subjugated the oceans and made them safe thoroughfares for the argosies of commerce. The gas engine is heralded as the engine of the future, its history is sketched, and the manner of its operation demonstrated. The live observer who is fascinated in watching the production of power and its application by means of machinery to the solution of natural difficulties and the removal of physical obstacles, will find in these bright pages enlightenment and genuine pleasure.

ADDRESSES TO ENGINEERING STUDENTS. Kansas City, Missouri: Waddell & Harrington, 1911. 8vo.; 493 pp. Price, $1.00.

The issuing of these addresses is largely a labor of love on the part of the compilers and publishers, the object being to provide students, at a cost barely covering expenses, with a work auxiliary to their text-books that shall imbue them with respect for their chosen profession, show them how to study to the best advantage, teach them to handle correctly and forcibly such English as is necessary to engineering expression, and develop in them high ideals toward ethics and accomplishment. Among the contributors are such men as Dr. Alexander C. Humphreys, Dr. Charles W. Eliot, Col. H. G. Prout, Prof. William H. Burr, and Rear Admiral George W. Melville, U. S. N. Ret. A glance at the index reveals the utmost diversity of subject-matter. No student can read the book conscientiously without being helped in many ways.

A LITERARY AND HISTORICAL ATLAS OF AMERICA. By J. G. Bartholomew, LL.D. London: J. M. Dent & Sons, Ltd. New York; E. P. Dutton & Company. 16mo.; 231 pp., 135 pages of maps. Price, 35 cents.

This is a volume in "Everyman's Library" and is a credit to this admirable series. That any kind of an atlas should be produced at such a ridiculously low price is a wonder; but when the atlas is a good one, the wonder increases. The maps are admirably colored, a point that our American mapmakers never seem to understand. The plans of revolutionary battles and of old New York are most interesting. The plates relating to early coinage are good.

JAHRBUCH DER LUFTFAHRT. II. Jahrgang 1912. Unter Mitwirkung vieler Fachleute herausgegeben von Ingenieur Ansbert Vorreiter in Berlin. Mit 775 Abbildungen, davon 120 auf 27 Tafeln, 27 Tabellen und 1 farbigen Tafel: "Die Ständer der Vereine des Deutschen Luftfahrer-Verbandes." Umfang 686 Seiten gr. 8vo. München: J. F. Lehmanns Verlag. Price, $3.

Vorreiter's Annual comes to us this year larger and more elaborate than in the past. From this interesting review we learn that Germany still stands foremost among the nations of the world in the number of its airships. The blunt bow which the Germans have experimentally demonstrated to be the most efficient form of entrance for an airship has now been adopted very generally. Even in the late Zeppelins it is to be found. So remarkable have been developments in the flying machine, that the author was compelled to exercise his good judgment as to what should be treated and as to what should be left out.

Particularly interesting is Prof. Reissner's chapter on Aero-Dynamic Institutions. An excellent index has been provided, which enables the reader to make good use of the vast fund of information contained in this valuable reference book.

PANAMA. The Canal, the Country, and the People. By Albert Edwards. New York: The Macmillan Company, 1912. 585 pp.; 50 half-tone illustrations.

The Isthmus of Panama, and particularly that strip of it known as the Canal Zone, is very much in the world's eye just now, and consequently the literature on the subject is increasing steadily. The work before us is an admirable contribution, and it has the advantage that it covers the field on a very broad plan. The author opens his work with a readable description of the trip from the West Indies to Colon—not by any means the least interesting and instructive part of a visit to the scene of America's greatest engineering work.

Although interest naturally centers in conditions as they are found to-day at the Isthmus, and particularly along the line of the canal, this work is much more than a description of the canal and its builders.

The subjects treated include among others the Geography of the Isthmus; the Coming of the White Man; the First Colonists; the Days of the Great Trade; Privateers and Pirates; the Buccaneers; the Wars of Independence, and the Panama Railroad. A well-deserved tribute is paid to our predecessors on the ground, the French; and especially interesting are the chapters explaining the secession from Colombia and beginning work; also the chapter on Col. Goethals, and one entitled: Transplanted Americans.

The writer wields a facile pen and is always interesting.

Use
L. & C. Hardtmuth's
"KOH-I-NOOR"
PENCILS IN 17 DEGREES AND COPYING.
If "Koh-i-noor" Quality won't satisfy you, nothing will.
"Koh-i-noor" Pencils of high-class stationers, dealers in drawing materials, artists' supplies, &c.
Illustrated list on application to:
L. & C. HARDTMUTH,
34, East 23rd Street, New York;
and Koh-i-noor House, London, England.

FREE SPECIMEN
'TABLOID' 'RYTOL'
UNIVERSAL DEVELOPER
Yields perfect negatives, prints, etc.
Send 2 cents to cover postage
BURROUGHS WELLCOME & CO., 35, West 33rd Street, N.Y.

TYPEWRITERS ALL MAKES
Visible Writers or otherwise
L.C.SMITHS, UNDERWOODS, OLIVERS, Etc.
¼ to ½ MFRS. PRICES
Shipped Anywhere for Free Trial or Rented, allowing Rent to Apply.
Prices $15.00 Up First class Machines. Full Guarantee. Write for Illustrated Catalog 10. Your opportunity.
TYPEWRITER EMPORIUM (Est. 1892), 34-36 W. Lake St., CHICAGO

Learn Watchmaking
We teach it thoroughly in as many months as it formerly took years. Does away with tedious apprenticeship. Money earned while studying. Positions secured. Easy terms. Send for catalog.
ST. LOUIS WATCHMAKING SCHOOL, St. Louis, Missouri

Incorporate Your PATENTS and BUSINESS in ARIZONA
Laws the most liberal. Expense the least. Hold meetings, transact business anywhere. Blanks, By-Laws and forms for making stock full paid for cash, property or services, free. President Stoddard, FORMER SECRETARY OF ARIZONA, resident agent for many thousand companies. Reference: Any bank in Arizona.
STODDARD INCORPORATING COMPANY, Box 8000
PHOENIX, ARIZONA

EPICYCLIC TRAINS, which play an important part in toothed gearing, are ably described in Scientific American Supplement 1524. Price 10 cents. For sale by Munn & Co., Inc., and all newsdealers.

15½ inches
New Invention
A TIGHT ROLLING
UMBRELLA
Send us $3.50 and we will deliver one, free of transportation. Agents wanted—side line for drummers.
GOAWAY BAG UMBRELLA CO., 109 Oliver St., Newark, N. J.

STUDY LAW
High-Grade Instruction by Correspondence
Prepares for the bar. Three Courses: College, Post-Graduate and Business Law. Nineteenth year. Classes begin each month. Send for catalog giving rules for admission to the bar of the several states.

Chicago Correspondence School of Law
506 Reaper Block, Chicago

GET YOUR SHARE
Large profits—easiest—fastest—biggest seller on the market today. National Self-Heating Gasoline Iron sells everywhere—town or country. Join our force of enthusiastic agents now. No time to lose. Complete demonstrating outfit, $4.50. Write for the facts.
National Stamping & Electric Works
402 S. Clinton Street, Chicago, Illinois

9,059-Word Business Book Free
Simply send us a postal—but ask for our free illustrated 9,059-word Business Booklet which tells how priceless Business Experience, squeezed from the lives of 112 big, broad, brainy business men, may be made yours—yours to boost your salary, to increase your profits. This free booklet deals with
—How to manage a business
—How to sell goods
—How to get money by mail
—How to buy at rock-bottom
—How to collect money
—How to stop cost leaks
—How to train and handle men
—How to get and hold a position
—How to advertise a business
—How to devise office methods
Sending for this free book binds you to nothing, involves you in no obligation, yet it may be the means of starting you on a broader career. Surely you will not deny yourself this privilege, when it involves only the risk of a postal—a penny! Simply say "Send on your 9,059-word Booklet." Send to
SYSTEM, Department 50-7, Wabash and Madison, CHICAGO.

Save ⅓ to ½ on Fuel Bills
Our Payment Plan Makes it Easy for You to Purchase a

JAHANT DOWN DRAFT FURNACE
Have plenty of heat wherever it is needed. We issue a 360 day Guaranty Bond that guarantees satisfaction. We sell direct paying freight and saving you dealer's profits. Install the Jahant yourself. We send complete outfit—furnace, pipes, registers, etc., with special plans, detailed instructions and necessary tools.
Send for free furnace book.
THE JAHANT HEATING CO.
75 Mill Street Akron, Ohio
BUY YOUR FURNACE $10 DOWN $10 A MONTH

Better Than Nails

After fitting the corners of a picture frame or the joints of other light work, have you ever ruined the whole thing by splitting it with a nail? Then you've had need for

LEPAGE'S GLUE

For, of course, glue won't split the weakest wood. Yet a square inch of glue makes as strong a joint as three six-penny nails do.

And is just as handy as nails or string. Put up in air-tight bottles, it positively cannot dry out. The last bit you scrape from the bottle with the metal spreader is as good as the first.

With the metal spreader you can use glue in places where you couldn't use a brush, and without muss or waste.

Get a 10c. bottle today and put it with the hammer and saw. Send, too, for our booklet—"Glueism." Gives 101 uses for glue in our new bottle and patent collapsible pin sealing tube.

RUSSIA CEMENT COMPANY

We manufacture Glues (hard or liquid) in bulk for all industrial purposes.

119 Essex Avenue Gloucester, Mass.

Library Slips with every Bottle and Tube.

HELMET OIL LUBRICATES ANYTHING SEND FOR SAMPLE FREE 118-124 North Clinton St. CHESLYA CO. CHICAGO U.S.A.

$7.50

AGENTS The Brand New Vacuum Cleaner

Nothing like it. The dirt can't get away. Perfect Suction. Light Weight. Every housewife wants this Labor Saver 250% profit.

Ralph Winter, Ohio, wires: "Ship another dozen at once. Orders rolling in"

Tom Morris made $87.50 last week. *You can do as well.*

This is your Big Opportunity. Be the first in your County. Write today for exclusive territory & free particulars.

B-B SALES COMPANY, 4938 N. Western Ave., Chicago

VEEDER Counters

Price $1.00

to register reciprocating movements or revolutions *Cut full size.* Booklet free.

VEEDER MFG. CO.
18 Sargeant St., Hartford, Conn.

Cyclometers, Odometers, Tachometers, Counters and Fine Castings.

Represented in Great Britain by MARKT & Co., LIMITED, 6 City Road, Finsbury Square, London, E. C.; France, by MARKT & Co., LIMITED, 107 Avenue Parmentier, Paris; Germany, Austria Hungary and Scandinavian Countries by LUDW. LOEWE & Co., Huttel. Strasse 17-20, Berlin.

3 in One

lubricates properly the sensitive mechanism. With perfect action the reel never fails at a critical moment. "3 in One" wont gum, dry out, contains no acid. "3 in One" prevents rust on every part, adding years to the life, and brightness to the beauty of even the finest. Good for the rod too—preserves the wood, promoting pliability—protects the metal. Good for fisher also—the delicate, pleasant odor keeps off mosquitos.

REAL REEL OIL

Try It. All dealers. Trial bottle sent free. Write to

THREE IN ONE OIL CO.
42 A Z F BROADWAY
New York City

10 DAYS FREE TRIAL

We ship on approval without a cent deposit, freight prepaid. DON'T PAY A CENT if you are not satisfied after using the bicycle 10 days

DO NOT BUY *a bicycle or a pair of tires* from *anyone* at *any price* until you receive our latest art catalogs illustrating every kind of bicycle, and have learned our unheard of prices and marvelous new offers.

ONE CENT is all it will cost you to write a postal and everything will be sent you free postpaid by return mail. You will get much valuable information. Do not wait, write it NOW

TIRES, Coaster-Brake rear wheels, lamps, sundries at *half usual prices.*

Mead Cycle Co. Dept. D-175 *Chicago*

What is the Principle of Relativity?

By W. J. Humphreys

THE discoveries made during the past fifteen or twenty years in the realm of physical science have been very numerous. Many have been of great practical or commercial value, and a few even startling in the amount of absolutely new information they gave of the workings of nature; and with them have come new or modified interpretations of various natural phenomena. But the modified interpretations are due to the fact that the new knowledge is *additional* knowledge and not, as some would have us believe, to any abandonment of the old. Indeed, the old established facts are more firmly established than ever, for no new discovery can possibly contradict an older one, whatever it may do to a preconceived speculation; it merely tells us of something else that *also* is true and for which room must therefore be made in any working hypotheses we may choose to adopt.

Different interpretations, however, of admitted facts are often possible until some crucial experiment or observation decides between them, or forces the consideration of an entirely new one. Who, for instance, from the mere phenomena of day and night could decide whether the sun remains fixed in the heavens while the earth turns round or the earth fixed while the sun rotates after the manner assumed by the old astronomers? But other phenomena connected with celestial motions were long ago observed and new discoveries made that rendered the older hypothesis less and less probable and finally placed the newer among those established facts concerning which there neither is nor can be room for discussion.

Numerous other phenomena, however, just as definite as the alternate succession of day and night, have not yet been so clearly and finally interpreted. Notable among these are the results of the ether-drift experiments of Michelson and Morley, notable because of their scientific importance and because of the amount of able discussion, including the already voluminous literature on the "Principle of Relativity," to which they gave rise.

As it is the specific purpose of this paper to give some idea of the much discussed "Principle of Relativity," it therefore will be worth while briefly to explain the above-mentioned experiments that caused it to be formulated.

If light is transmitted with constant velocity from one place to another by a fixed and universal ether, it follows that the time required for light to travel from a given point on a moving body to a mirror at a fixed distance from that point and back would be greatest when the line connecting them is along the path of travel, and least when at right angles to it. To test this conclusion Michelson and Morley divided a beam of monochromatic light at a reflecting-transmitting surface in such manner that after following paths at right angles to each other for a certain distance the two parts were reflected back on these paths and so united that any change in the length of either optical path, unless accompanied by an equal change of the same kind in the other, could be detected by interference fringes. But no matter how the apparatus was varied there was no observable change in the interference of the two beams of light; the ether seemed stationary with reference to the earth in spite of the fact that its orbital velocity about the sun is some 19 miles per second.

Here indeed was a puzzling situation. The aberration of the stars, or the change in their apparent positions, in strict conformity to the motions of the earth through space, indicated that the ether was fixed and that the earth passed through it without obstruction; but on the other hand the observations of Michelson and Morley seemed flatly to contradict such an interpretation in regard to the relative motions of earth and ether. How to reconcile these facts was not obvious. They challenged and got the attention of some of the ablest physicists and mathematicians of the age, and thus more than one ingenious hypothesis was advanced and nobly defended. But the most comprehensive of these hypo-

Copyright, U. S. A., 1912, by The B. V. D. Company.

"Bank on" B. V. D.

And Draw Comfort-Interest All Summer.

DON'T overheat and overweight your body with tight-fitting, full-length undergarments. Wear cool *Loose Fitting* B. V. D. Coat Cut Undershirts, Knee Length Drawers or Union Suits. They are made of light, durable woven materials, soft to the skin. Quality of fabrics, true-to-size fit, careful workmanship and long wear are assured and insured by

This Red Woven Label

MADE FOR THE B.V.D. BEST RETAIL TRADE

(Trade Mark Reg. U. S. Pat. Off. and Foreign Countries.)

B. V. D. Coat Cut Undershirts and Knee Length Drawers, 50c., 75c., $1.00 and $1.50 the garment.

B. V. D. Union Suits (Pat. U. S. A. April 30th, 1907.) $1.00, $1.50, $2.00, $3.00 and $5.00 the suit.

The B. V. D. Company, New York.

London Selling Agency: 66, Aldermanbury, E. C.

¶ OUR NEW CATALOGUE OF SCIENTIFIC *and* TECHNICAL BOOKS

WE have just issued a new catalogue of scientific and technical books, which contains the titles and descriptions of 3500 of the latest and best books published, covering the various branches of the arts, sciences and industries.

¶ Our "Book Department" can supply these books, or any other scientific or technical books published, and forward them by mail or express prepaid to any address in the world on receipt of the regular advertised price.

¶ Send us your name and address and a copy of this catalogue will be mailed to you free of charge.

Munn & Co., Inc., *Publishers*, Scientific American Office, 361 Broadway, N.Y.

Chicago Beach Hotel

American Plan | Summer's Most Ideal Spot | European Plan

A delightful haven of rest and recreation. Splendidly located on Lake Michigan adjoining the great South Parks it is wonderfully attractive in summer. In the city—ten minutes ride to theatre and shopping district, yet amidst beautiful country surroundings. Bathing beach, golf links, tennis courts, lagoons for boating—every outdoor amusement. Excellent food with best of service. **Booklet on request to Manager, 51st Blvd. and Lake Shore, Chicago**

Magnificent Steel Launch $96

Complete with Engine, Ready to Run

18-20-22 and 27 ft. boats at proportionate prices. All launches tested and fitted with Detroit two cycle reversible engines with spoon centre-lifting lever—simplest engine made—starts without cranking—has only 3 moving parts—anyone can run it. **The Safe Launch**—absolutely non-sinkable—needs no boathouse. All boats fitted with air-tight compartments—cannot sink, leak or rust. We are sole owners of the patents for the manufacture of rolled steel, lock-seamed steel boats.

Orders filled the day they are received. Boats shipped to every part of the world. **Free Catalog. Steel Row boats. $30.** (93)

MICHIGAN STEEL BOAT CO., 1332 Jefferson Avenue, Detroit, Mich., U. S. A.

Vacuum Cleaners Broomell's "VICTOR" Electric Stationary

We make a specialty of Electric *Stationary* and Electric Portable *Vacuum Cleaners* for *residence work*, also a Stationary for *Country Homes*, for use with Gasoline Engine. *Positive, noiseless, valveless, Rotary Pump. The very best* machines in *the world.* Send for booklet. Buy direct.

VICTOR CLEANER COMPANY, York, Pennsylvania

Wealth from Waste

¶ "Give me the sewage of New York city," cried a knowing modern chemist, "and I will return annually the milk of 100,000 cows."

¶ Lord Palmerston voiced the same thought when he said: "Dirt is merely matter in the wrong place." The dump heaps of our forefathers have become our mines.

¶ No fairy story is more fascinating than the tale of the utilization of waste. At the touch of the chemist's wand old shoes are miraculously transformed into jelly; alcohol is wonderously charmed out of old shirts; love-letters are written on what was once an old linen cuff, with ink made from the rusty hoop of an old barrel.

¶ In the next mid-month magazine number of the Scientific American, which will be issued on June 15, the story of making money out of waste will be told in all its fascinating details.

¶ You will learn how coal tar, a noisome ooze that was once thrown away, has become the most protean substance in the world. The chemist has found it to be a palette of gorgeous colors, an arsenal of deadly explosives, a medicine chest of healing potions, a vial of sweet odors—in a word, the most wonderful, complex substance in the world.

¶ You will learn, too, how the packing industries utilize by-products. Nothing escapes the boiling kettle or the machine. A steer is utilized from the tip of his horn to the last hair of his tail.

¶ You will read something of the wonderful story of the transformation of wood waste. For three dollars you can buy a suit of clothes in Germany made of paper yarn—the product of chips and branches. The silk scarf that you wear may be but the transformed block of wood that was thrown away by some reckless lumberman.

¶ In a word, the June mid-month number will show you what Hamlet meant when he inquired:

"Why may not imagination trace the noble dust of Alexander till we find it stopping a bunghole?"

¶ On all newsstands.

theses, and, if true, the most important development of physical science since the discovery of universal gravitation, if it does not exceed even that, is the "Principle of Relativity."

In a certain sense the Principle or Theory of Relativity is only an extension to light and electricity of particular laws known since the time of Galileo to be applicable to material bodies. We are told for instance that the kinetic energy of a given mass is directly proportional to the square of its velocity. But while this sentence is grammatically correct, scientifically it is without definite meaning. An object has no linear velocity except in comparison with something else, and hence at the same instant it has many different velocities, one velocity with reference to one thing, another with reference to a different thing, and so on for as many objects as we may wish to compare it with, and therefore for each or with reference to each it has an amount of kinetic energy which, in general, is different from the amount it has with reference to any other. That is to say, a mass does not possess kinetic energy absolutely, but only relatively to some other body.

Now the "Principle of Relativity" as applied to light and electrical phenomena begins by postulating two things:

a. An observer on an object moving with uniform velocity can not even detect, much less measure, that velocity by any sort of observations confined to the moving object itself.

b. The measured velocity of light in space is independent of any constant relative velocity of source and observer, and always the same.

These postulates, if true, fully account for the failure of the Michelson and Morley experiments to detect any drift of the ether. But this is not all. They seem to deny the existence of a light conveying medium, and to force a return to something akin to the old corpuscular theory of light transmission. The experimental failure to detect ether drift is summarily disposed of by the assertion that there is no ether to drift, but no adequate explanation, in keeping with the "Principle of Relativity," has yet been offered for the phenomenon of light interference, nor for the fact that monochromatic lights of all wavelengths (assuming this expression still permissible) travel with the same velocity, nor for a host of other stubborn facts of experiment. Further, it compels a new system of mechanics and even denies the observable independence of time and space, and makes time, in any way we can actually note it, such a function of velocity that there is no such thing and can be no such thing as a universal now—one man's now being another man's past and still another's future. But of course such strange conclusions as these are deducible only from certain convenient equations, and have nothing to do with objective realities. To say that time and space actually are interchangeable, that time (not its measure) really depends upon velocity, or that there is no such thing as an actual (not observable) now, is to talk the veriest nonsense.

But is the "Principle of Relativity" true? That is for experiment to decide. Its postulates have been and are now being pursued by the relentless logic of mathematics, and they must stand or fall as the deductions thus reached agree or conflict with experimental evidence. Just now, however, the "Principle of Relativity," as set forth by some of its most ardent advocates, like non-Euclidian geometry and the geometries of $3 + n$ dimensions, seems to be irresistibly fascinating to mathematicians, but equally abhorrent to that host of physicists who can no more conceive of time as a function of velocity than they can imagine space to be curved or picture to themselves a fourth dimension.

Guide Post and Utility Column.—A Chicago inventor has devised a post for street corners in which is combined a mail box, a fire-alarm box, a police department telephone, and a general directory of the surrounding locality. The posts are of ornamental design and provide space for placards on which directions for reaching important points may be published.

Panama—Personal Impressions of the Work

(*Concluded from page 517.*)

five years, is to relieve the pressure at the base of incipient slides, by removing the material from the top of the cut. As soon as a serious slide develops, steam shovels are set to work in benches, and they continue until a point is reached when equilibrium is finally established.

Among the many profound impressions which I have brought away with me from the Isthmus of Panama, none is so lasting as that of the enormous magnitude of the slides at Culebra and the quiet confidence with which the American forces are setting themselves to meet the difficulty. Standing one day at the bottom of the excavation I asked a bronzed and keen-eyed American superintendent what he would do if a wide strip of the side of the hill, which showed signs of breaking away, should come into the canal. His answer, laconically delivered, was simple and to the point: "Dig it out"—and there you have the whole situation. Nature has laid a heavy toll upon man for his interference with her age-long repose. Proof of this is seen in the total of over 15,000,000 cubic yards, which have had to be laboriously shoveled on to cars and taken out by the train load to far-distant dumping grounds. But from chief engineer down to dirt car conductor, no one appears to have been dismayed by the portentous movements of the mountain side. Great are the steam shovel, the dirt train and the unloading plough! Slowly but inevitably they have won out in this gigantic contest. Col. Goethals, in his last annual report, speaking of the slides, says: "Experience shows that it is only a question of time when they will cease entirely."

The Spectrum of the Aurora

THE spectrum of the aurora, if accurately interpreted, would presumably furnish valuable information as to the composition of the atmosphere up to a great altitude.

The history of the auroral spectrum practically begins with the observations of Angström, in 1867–68. This observer noticed a brilliant greenish line, the wave length of which he determined to be 5,567 Angström units. Since then the spectrum of the aurora has been repeatedly observed; and, though numerous other lines have been seen from time to time, the green line at approximately the position determined by the Swedish observer, is universally described as the dominant feature of the spectrum, and is therefore referred to as "the auroral line." The identity of this line has been the subject of much discussion. Until recently the consensus of opinion has attributed it to krypton, one of the rare gaseous constituents of the atmosphere. In the *Monthly Weather Review* for September, 1907, Dr. W. M. Watts published a valuable summary of the information available on this subject up to the time he wrote.

Since then the krypton hypothesis has been attacked from several quarters. The evidence furnished by the position of the line is not conclusive, as the measurements of different observers vary. Krypton is a heavy gas (atomic weight 83.0) and is therefore probably confined to the lowest strata of the atmosphere. On the other hand, it was observed by La Cour, who was associated with Paulsen in important studies of the aurora made in Iceland, that the so-called "homogeneous arcs," the altitude of which was trigonometrically determined to be from 250 to 300 miles, invariably showed the green auroral line alone in their spectrum, while lower forms of the aurora generally had more complex spectra. As long ago as 1890 it was suggested by Scheiner that the auroral line might be due to an unknown gas, lighter than any of the known elements. The existence of such a gas, having an atomic weight of 0.4, was predicted by Mendeléeff, from the periodic law. Finally, about the beginning of last

Practical Books

Popular Hand Book for Cement & Concrete Users

By MYRON H. LEWIS, C. E., and ALBERT H. CHANDLER, C. E. Octavo, 430 pages, 126 illustrations. Price, $2.50.

¶ A concise and comprehensive treatise on the principles and methods employed in the manufacture and use of concrete and its products in all classes of modern work. It is a standard work of reference covering the various uses of concrete both plain and reinforced. Everything of value to the concrete user is given, including kinds of cement employed in construction, concrete architecture, inspection, and testing, waterproofing, coloring and painting, rules, tables, working and cost data. It is a thoroughly practical work, clearly written, systematic and logical in its arrangement, broad in its scope, and gives a lucid explanation of, and a clear insight into the fundamental principles employed in concrete design and construction. The practical value of the book is enhanced by over thirty-five useful tables, and concise statements of rules and methods.

Standard Practical Plumbing

By R. M. STARBUCK. Octavo, 406 pages, 347 illustrations. Price, $3.00.

¶ This is a complete practical treatise and covers the subject of modern plumbing in all its branches. It treats exhaustively on the skilled work of the plumber and the theory underlying plumbing devices and operations, and commends itself at once to everyone working in any branch of the plumbing trade. A large amount of space is devoted to a very complete and practical treatment of the subjects of hot water supply, circulation and range boiler work. Another valuable feature is the special chapter on drawing for plumbers. The illustrations, of which there are three hundred and forty-seven, one hundred being full page plates, were drawn expressly for this book and show the most modern and best American practice in plumbing construction

Drop Forging, Die Sinking and Machine Forming of Steel

By JOSEPH V. WOODWORTH. Octavo, 341 pages, 304 illustrations. Price, $2.50.

¶ A complete practical treatise on the hot and cold machine forming of steel and iron into finished shapes, together with the tools, dies and machinery involved in the manufacture of duplicate forgings and interchangeable hot and cold pressed parts from bar and sheet metal. It is a comprehensive and modern work, written by an expert, and treating fully on modern shop practice, processes, methods, machines, tools and details.

Dies: Their Construction and Use for the Modern Working of Sheet Metals

By JOSEPH V. WOODWORTH. Octavo, 384 pages, 505 illustrations. Price, $3.00.

¶ A practical treatise on the design, construction and use of dies, punches, tools, fixtures and devices, together with the manner in which they should be used in the power press, for the cheap and rapid production of sheet metal parts and articles. The hardening and tempering of press tools and the classes of work which may be produced to the best advantage by the use of dies in the power press are fully treated. The illustrations show dies press fixtures and sheet metal working devices, the description of which are so clear and practical that all metal working mechanics will be able to understand how to design, construct and use them.

Punches, Dies and Tools for Manufacturing in Presses

By JOSEPH V. WOODWORTH. Octavo, 483 pages, 702 illustrations. Price, $4.00.

¶ This work is a companion to the author's elementary work entitled "Dies, Their Construction and Use." It does not go into the details of die making to the extent of the author's previous book, but gives a comprehensive review of the field of operations carried on by presses. This book might well be termed an encyclopedia of die making, punch making, die sinking, sheet metal working, and making of special tools, sub-presses, devices and mechanical combinations for piercing, punching, cutting, bending, forming, drawing, compressing and assembling sheet metal parts and also articles of other materials in machine tools.

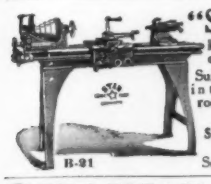
American Tool Making and Interchangeable Manufacturing

By JOSEPH V. WOODWORTH. Octavo, 535 pages, 601 illustrations. Price, $4.00.

¶ A complete practical treatise on the designing, constructing, use and installation of tools, jigs, fixtures, devices, special appliances, sheet metal working processes, automatic mechanisms and labor saving contrivances, together with their use in the lathe, milling machine, turret lathe, screw machine, boring mill, power press, drill, sub-press, drop hammer, etc., for the working of metals, the production of interchangeable machine parts and the manufacture of repetition articles of metal. The treatment of each tool described and illustrated is such as to enable any practical man to design, construct and use special tools, dies and fixtures for rapid and accurate production of metal parts interchangeably.

Any of these books will be sent, postpaid, on receipt of advertised price

MUNN & CO. Inc., *Publishers*
361 Broadway New York City

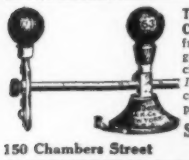


"STAR" Large Line of Attachments
For Foot or Power LATHES
Suitable for fine accurate work in the repair shop, garage, tool room and machine shop.
Send for Catalogue B
SENECA FALLS MFG. CO.
695 Water Street
Seneca Falls, N. Y., U.S.A.
B-91

SEBASTIAN LATHES
9 to 15 Inch Swing
High Quality *Low Prices* *Catalog Free*
THE SEBASTIAN LATHE CO., 120 Culvert St., Cincinnati, O.

The "BARNES" Positive Feed
Upright Drills
10 to 50-inch Swing
Send for Drill Catalogue
W. F. & Jno. Barnes Co.
Established 1872
1999 Ruby Street Rockford, Illinois

SOUTH BEND LATHES
Screw Cutting
9 to 13-inch Swing
Power, Foot & Electric Drive
Interesting Catalog Free
South Bend Machine Tool Co., 421 Madison St., South Bend, Ind.



This "Red Devil" Circular Glass Cutter No. 263 cuts perfect circles from 2 to 22" in window or plain glass. It's the ONLY practical circular hand glass cutter made. *It's a Red Devil.* If your dealer can't furnish it, we will send one prepaid for $1.25.
Smith & Hemenway Co.
150 Chambers Street New York, N. Y.

THREE MEASUREMENTS AT ONE SETTING WITHOUT DEDUCTING

Get the S & S Vernier Caliper. Be prepared to take measurements of inside, outside or depth; English and metric. Handy to carry in your pocket, convenient and valuable device.
Price $3.50 with adjusting screw or $2.50 without.
SCHUCHARDT & SCHUTTE, West Street Bldg., NEW YORK

Solders and Soldering

¶ If you want a complete text book on **Solders** and the art of **Soldering**, giving *practical, working* recipes and formulæ which can be used by metallurgist, the goldsmith, the silversmith, the jeweler, and the metal-worker in general, read the following *Scientific American Supplements:* 1112, 1384, 1841, 1610, 1622, 1434, 1533; price 70 cents by mail.

¶ Order from your newsdealer or from
MUNN & COMPANY, *Inc.*
Publishers 361 Broadway New York

MODELS CHICAGO MODEL WORKS
166 W. MADISON ST. CHICAGO, ILL.
ESTABLISHED 1887 WRITE FOR CATALOGUE OF MODEL SUPPLIES

INVENTORS We build models, do experimental work, light manufacturing dies and tools.
G. SCHWARZ & CO., 123 Liberty St., N.Y.

THE SCHWERDTLE STAMP CO.
STEEL STAMPS LETTERS & FIGURES.
BRIDGEPORT CONN.

ELECTRONS AND THE ELECTRONIC THEORY are discussed by Sir Oliver Lodge in Scientific American Supplements 1428, 1429, 1430, 1431, 1432, 1433, 1434. Price 10 cents each. For sale by Munn & Co., Inc., and all newsdealers.

MASON'S NEW PAT. WHIP HOIST
for Outrigger hoists. Faster than Elevators, and hoist direct from teams. Saves handling at less expense.
Manufactured by VOLNEY W. MASON & CO., Inc.
Providence, R. I., U. S. A.

WANTED To manufacture METAL SPECIALTIES, 20 years experience in making Dies, Tools and Special Machinery. Expert work. Complete equipment.
NATIONAL STAMPING & ELECTRIC WORKS
Dept. 2, 412 So. Clinton Street, - Chicago, Ill.

Experimental & Model Work
Circular and Advice Free
Wm. Gardam & Son, 82-86 Park Place, N. Y.

ICE MACHINES Corliss Engines, Brewers and Bottlers' Machinery
The VILTER MFG. CO.
899 Clinton Street, Milwaukee, Wis.

Magical Apparatus
Grand Book Catalog. Over 700 engravings 25c. Parlor Tricks Catalog Free.
MARTINKA & CO., Manufacturers, 493 Sixth Avenue, New York

Print Your Own
Cards, circulars, books, newspaper. Prem $5, Larger $18, Rotary $60. Save money. Big profit printing for others. All easy, rules sent. Write factory for press catalog. TYPE, cards, paper, &c.
THE PRESS CO., Meriden, Connecticut

year, Dr. Alfred Wegener advanced several arguments in favor of the predominance of such a gas in the uppermost regions of the earth's atmosphere, probably identical with the coronium of the outermost envelope of the solar atmosphere. Pending the establishment of such identity he proposed to call it "geocoronium." Wegener assumes for this gas the atomic weight of Mendeléeff's hypothetical light element, and computes its volume percentage at different levels in the atmosphere, ranging from 0.00058 per cent at the earth's surface to 93 per cent at an altitude of 500 kilometers (310 miles).

Another objection to the krypton hypothesis has recently been urged by T. W. Page (Proceedings Physical Society of London, April 15th, 1912), viz., the absence from the auroral spectrum of a conspicuous yellow line, at 5871.12, in the spectrum of krypton. He has carried out a series of experiments to ascertain whether under any kind of electrical discharge the intensity of the yellow line in the spectrum of krypton is materially reduced as compared with that of the green line. He concludes that his experiments show "that the yellow line of krypton persists in about the same intensity as the green under widely varied conditions of stimulation." Hence, the fact that the green auroral line occurs alone appears to show that it is not due to krypton.

A Forest Service Circular on Gum Woods

BULLETIN 103, issued by the United States Forest Service, is devoted to the distinguishing characteristics of the North American gum woods. The data contained in this bulletin are to form a part of an elaborate work on all the principal groups of native woods; the part pertaining to the gum woods is published now to make the information speedily available, while detailed descriptions of other groups are being prepared. The importance of trustworthy information regarding the gum woods is evident from the fact that they represent the bulk of the available hardwoods in the Atlantic and Gulf States. The annual cut, which has doubled itself during the last four years, is certain to continue to increase very rapidly as the other hardwood and pine supplies in the South decrease.

The gum woods under consideration are the cotton gum (*Nyssa aquatica*), water gum (*Nyssa biflora*), black gum (*Nyssa sylvatica*), and sour gum (*Nyssa ogeche*). The names of timbers in the market are often used interchangeably and the materials are mixed in the mill and in the yard. For this reason it became necessary to determine microscopic distinctions of the four species. The analytical key prepared for the identification of the different species is based upon the gross and minute anatomy of the secondary wood of the mature stem. In addition to the key, descriptions are given of the different woods and their elements, together with the geographical range of each species and other useful information, including a list of common or trade names. These descriptions are followed by illustrations of typical wood elements of this group and by table giving accurate measurements and comparisons of length and width of the elements of each species, together with results of the specific gravity determinations of the air-dried wood. Accurate illustrations of the magnified transverse section of the four gum woods are shown, which will enable the layman with a little practice in examining woods with a hand lens to identify satisfactorily each species.

When it is considered with what care these determinations and descriptions have been made, the large number of different samples of the same species examined, and the uniformity of the methods employed, it will be seen that this work is of real value and easily ranks among the best original work that has yet been accomplished by the purely technical offices of the Forest Service. The bulletin, though technical in its treatment, is written with a conciseness and a clearness that will be easily understood by the intelligent lay reader.

The United States Tire Company Believes Its Tires are the Lowest-Cost Tires in the World

No other tires in the world are made under conditions so favorable to the greatest possible tire durability.

In no other tires is there combined the tire knowledge, skill and experience of four corps of master tire builders.

In United States Tires only is the motorist protected by a four-factory "check" against defects of any and every kind.

United States Tires offer you in a single tire a combination of the strongest features of four world-famous brands.

Made in Clincher, Dunlop (straight side) and Quick Detachable Styles.

Cost No More Than Other Kinds

UNITED STATES TIRE COMPANY
NEW YORK

THE EDISON CONCRETE HOUSE ¶How it is constructed, how much it will cost, is it practical from an architectural and engineering standpoint? These and other important questions relating to the structure are discussed in a good, thorough, illustrated article published in *Scientific American Supplement 1685*. Price 10 cents by mail. Order from your newsdealer or from
¶ MUNN & COMPANY, Inc. *Publishers*
361 Broadway, New York

When the whistle blows and it's time to "wash up," be sure there's plenty of Old Dutch Cleanser in the wash-room. Nothing equals it for the hands. The fine particles cut all grime, greasy dirt and skin stains which soap cannot remove. It leaves the hands white and smooth. Takes the sticky scum from wash-bowls in a jiffy, makes cleaning everywhere doubly easy—and is absolutely indispensable for any and all uses in shop, office and factory. Only one cleanser necessary when Old Dutch is used

MANY USES ON LARGE SIFTER-CAN 10c.

Old Dutch Cleanser

Always Keep a Big Supply on Hand

BOOKS

Everybody Can Now Afford
Dr. Eliot's Five-Foot Shelf of Books

A New Popular Edition

FOR several years we have been at work improving printing processes—devising new and more efficient methods of producing good books—and reducing costs here and there while raising the quality of our product.

To accomplish this we called to our aid the ablest minds in the mechanical world.

We were convinced that the cost of standard, well-made books could be decreased, without sacrifice of high quality, to a point where every man could afford to buy the best literature.

We have succeeded in doing this by a development of efficiency in every line—by the adoption of time-saving and labor-saving methods, by production on a large scale, and by economical methods of distribution and sale.

The first result of these improved methods is a popular edition of the Harvard Classics, commonly known as Dr. Eliot's Five-Foot Shelf of Books.

If you do not own the Harvard Classics now is the time to obtain a set of the new Popular Edition at a price that puts this famous library of classics within everybody's reach.

Dr. Charles W. Eliot

This new, low-priced edition *contains every chapter, every page, every word, that is found in the expensive de luxe editions.*

It differs only in illustrations and bindings.

It is printed from the same clear-cut plates that were used in printing the celebrated Cambridge Edition.

The Popular Edition is well-made, handsomely and substantially bound, and is worthy of a place in any library.

This Edition is Dr. Eliot's Own Idea

In publishing this edition of the Harvard Classics we are carrying out Dr. Eliot's idea of the place this library should permanently hold as an educational influence.

He intended the Harvard Classics for the millions of men and women who are busy doing the nation's work—professional men, office men, farmers, salesmen, mechanics—for readers who have no time to read a roomful of books to gain a clear perspective of the world's thought and achievement.

"The World's Civilization on a Bookshelf"

That is a sweeping statement—"the world's civilization on a bookshelf"—to be used in describing a set of books.

It is not our own phrase. One of the readers of the Harvard Classics used it in writing to us about the set.

But sweeping as it is, it is true in the sense in which he used it.

Every powerful idea that has ever moved the human mind is to be found in these volumes.

It is a collection of books that has no parallel in the history of literature, because it is the product of a plan to present, in the limits of a single bookshelf, a series of volumes which would show the complete development of the human intellect.

It is not merely a collection of great books, printed in uniform binding, without coherence or system.

Every part of the library bears a relation to every other part.

Every book, play, or poem or article in the set *is complete in itself.* It contains no unsatisfactory, chopped-up extracts.

You may learn here, in one volume, Darwin's epoch-making theory of evolution. Then, here are the finest examples of the Greek comedies, full of the genuine humor of a people dead two thousand years. Next the Arabian Nights, that eternal collection of never-old tales—and there are the subtle ideas of Descartes, the father of logic—the essays of Montaigne—the best books of the Bible, the Koran, and the sayings of Confucius—Adam Smith's famous "Wealth of Nations," the foundation of the science of political economy—and there is Shakespeare, Goethe, Milton, Burns, the world's great poets—the life-stories of the intellectual leaders of the human race, and—

The table of contents alone would fill several pages. The best way to learn all about the set is to write now for our

64-Page Book (Sent Free)

This book describes the Harvard Classics, and gives Dr Eliot's own official statement of the plan of the work. It is a beautifully printed little book, and is well worth reading.

The coupon printed as a part of this advertisement is for your convenience. Just fill it out and mail it to us, and we will send the 64-page book by the next mail.

P. F. Collier & Son, Inc.

Publishers of Good Books **416 West 13th St., New York**

Sci. Am. 6-8

P. F. Collier & Son, Inc.
416 West 13th Street, New York

Please send to me by mail, free of charge, the 64-page book describing The Harvard Classics, Dr. Eliot's Five-Foot Shelf of Books.

*Name*_____

*Address*_____

We want a few experienced special representatives in good localities to represent us in the distribution of the Popular Edition. Write direct to our main office in New York, or apply personally to any branch office.